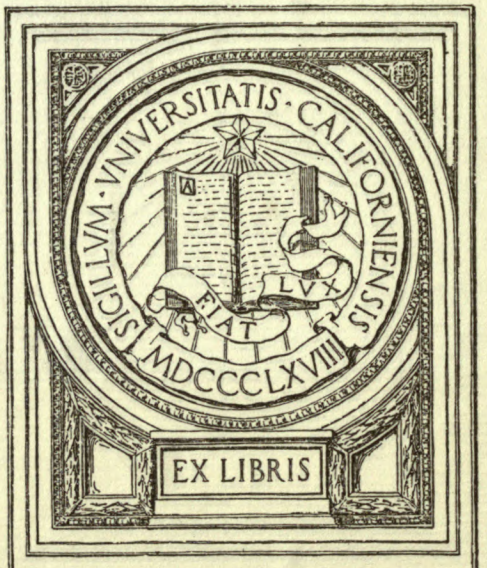
LIBRARY
UNIVERSITY OF
CALIFORNIA

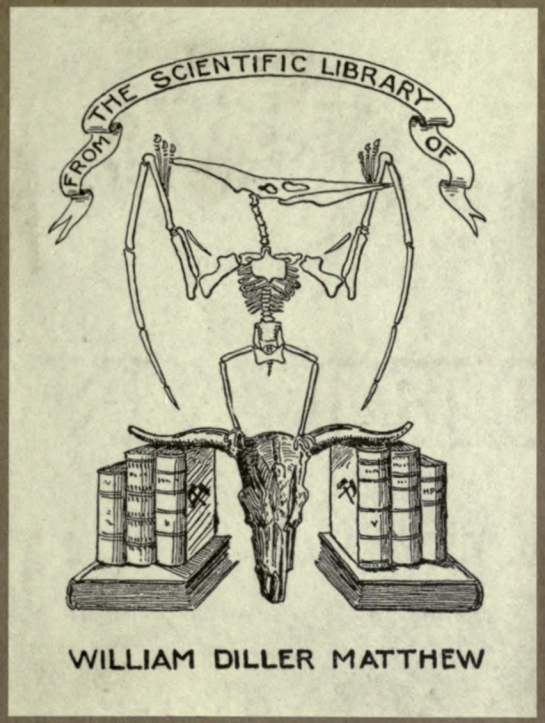
EARTH
SCIENCES
LIBRARY

EARTH
SCIENCES
LIBRARY

GIFT OF
WILLIAM DILLER MATTHEW



EX LIBRIS



WILLIAM DILLER MATTHEW

Memoirs of the Boston Society of Natural History.

Volume 8, Number 2.

Monographs on the Natural History of New England.

THE WHALEBONE WHALES OF NEW ENGLAND.

By GLOVER M. ALLEN.

WITH NINE PLATES.

BOSTON:

PRINTED FOR THE SOCIETY WITH AID FROM
THE GURDON SALTONSTALL FUND.

September, 1916.

Memoirs of the Boston Society of Natural History.

Volume 8, Number 2.

Monographs on the Natural History of New England.

UNIV. OF CALIFORNIA

THE WHALEBONE WHALES OF NEW ENGLAND.

By GLOVER M. ALLEN.

WITH NINE PLATES.

BOSTON:

PRINTED FOR THE SOCIETY WITH AID FROM
THE GURDON SALTONSTALL FUND.

September, 1916.

QL737
C4A57
MATTHEW LIBRARY
EARTH SCIENCES LIBRARY
UNIV. OF CALIFORNIA
Gift of W. D. Matthew

CONTENTS.

PAGE.

Introduction 109
The Whalebone Whales 110
Whalebone Whales of New England 111
Key for Identification of Stranded Specimens 112
Field Key to Whalebone Whales of New England 113

NORTH ATLANTIC RIGHT WHALE (*Eubalaena glacialis*) 114

History and Nomenclature 114
Vernacular Names 115
Description 116
Form 116
Color 117
Hair 118
Baleen 118
External Measurements 118
Skeleton 120
Appearance and Actions 125
Spout 125
Schools 125
Disposition 126
Food 128
Stranding 129
Breeding Habits 129
Occurrence in New England Waters . . . 131
Former Abundance 131
Seasonal Occurrence 132
Fossil Remains 144
New England Right Whale Fishery . . . 145
Early Whaling at Cape Cod and Massachusetts Bay 146
The Whale-viewer 152
Whaling Accidents 154
Ministers' Salaries 156
Strife over Drift Whales 156
Employment of Cape Cod Indians . . 158
Decline of Cape Cod Whaling 158
Methods of Whaling 160
Early Whaling at Cape Ann 162
Whaling at Nantucket and Martha's Vineyard 163
Early Whaling in Rhode Island . . . 168
Whaling in Connecticut 170
Yield of Oil and Baleen 170
Enemies and Parasites 172
Jonah and the Whale 174
An Indian Totem 174

COMMON FINBACK WHALE (*Balaenoptera physalus*) 176

History and Nomenclature 177
Vernacular Names 179
Description 180
Form 180
Plicae 180
Color 181
Hair 182
Baleen 182
External Measurements 183
Weight 184
Auditory Apparatus 185
Musculature 185
Visceral Anatomy 186
Skeleton 186
Movements and Spouting 192
Schools 194
Rest 195
Accidents and Fatalities 195
Food 200
Breeding Habits and Young 204
Range 205
Occurrence in New England Waters . . . 206
Finback Whaling on the New England Coast 222
Commercial Value 231
Enemies and Parasites 233

RUDOLPHI'S RORQUAL (*Balaenoptera borealis*) 234

History and Nomenclature 234
Vernacular Names 235
Illustrations 235
Description 235
Form 235
Plicae 235

734597

Color 235
Hair 236
Baleen 236
External Measurements 236
Skeleton 237
Range 238
Occurrence in the Western Atlantic . . 239
Occurrence in New England Waters . . . 239
Habits 240
Food 241
Commercial Value 241
Enemies and Parasites 242

Blue Whale (*Balaenoptera musculus*) 243

History and Nomenclature 243
Vernacular Names 245
Description 245
Plicae 246
Color 246
Hair 247
Baleen 248
Weight 248
External Measurements 249
Musculature 250
Skeleton 251
Habits 252
Longevity 254
Food 254
Breeding Habits 254
Geographic Distribution 255
Occurrence in New England Waters . . . 256
Enemies and Parasites 257

Little Piked Whale (*Balaenoptera acuto-rostrata*) 258

History and Nomenclature 258
Vernacular Names 260
Description 261
Plicae 261
Color 261
Hair 261
Baleen 263
External Measurements 263
Musculature 264
Visceral Anatomy 267
Skeleton 268
Appearance and Actions 272
Food 273
Breeding Habits 274
Geographic Distribution 274
Occurrence in New England Waters 275
Economic Value 280
Enemies and Parasites 280

The Fossil Finback of Gay Head (†*Balaenoptera ?sursiplana*) 282

Occurrence of the Fossils 282
Indian Myth of their Origin 283
Age of the Fossils 284
Miocene Conditions 284
Economic Value of the Bone-bearing Strata 285
Descriptions 285

Atlantic Humpback Whale (*Megaptera nodosa*) 288

History and Nomenclature 288
Vernacular Names 290
Description 291
Form 291
Vestiges of Teeth 292
Weight 292
Color 292
Hair 293
Baleen 293
External Measurements 293
Musculature 295
Skeleton 296
Appearance and Actions 299
The Whale and Swordfish Story . . . 301
Voice 302
Accompanying Vessels 303
Food 303
Breeding Habits 304
Longevity 305
Occurrence in New England Waters . . . 305
Humpback Whale Fishery in New England Waters 311
Yield of Oil 315
Enemies and Parasites 315

Literature 317

Introduction.

In the year 1725, Paul Dudley, an eminent citizen of Massachusetts, communicated to the Royal Society of London "an Essay upon the Natural History of Whales." This account, he tells us, "respects only such Whales as are found on the Coast of *New-England*. And of these there are divers Sorts." His information, though apparently taken for the most part at second hand, was none the less substantially accurate, and his paper forms a landmark in the early history of cetology. Many of the naturalists of the eighteenth century were indebted to it for the accounts of whales in their compilations. Since that early date the literature on whales and whaling has multiplied to an appalling degree, so that at the present day there is probably no other order of mammals of which so much has been written, but so little is accurately known. For whales cannot be observed or compared at will or without much labor. Yet at the present day, it may fairly be said that the larger living species are clearly differentiated and that it remains to fill in the many details of their life histories, their distribution, variation, and comparative anatomy. The influence of whaling on the development of naval skill and on commerce and exploration need only be mentioned to recall the universal and romantic interest of this pursuit. For a great part of the two past centuries, whaling has been a characteristic occupation of the New England seamen, and notwithstanding the diminution in number of whales and the lessened market for their products, a few vessels still clear from New Bedford for the fishery in tropic and arctic seas.

The present account aims to give a general description of the species of whalebone whales inhabiting the waters off the New England coast, together with a summary of what is known of their habits and particularly of their occurrence and importance within the New England limits.

The full-page plates illustrating the several species are drawn by Mr. J. Henry Blake, who, to his rare artistic skill, brings also a considerable first-hand knowledge of the appearance of cetaceans. All these figures are drawn very carefully to scale from actual measurements, in part taken by himself, in part by us both, or from the tables of dimensions in Dr. True's (1904) monumental work on the Western Atlantic whales. As representations of the general appearance and proportions of these huge mammals, I believe they are the best figures hitherto made. For photographs of stranded whales, even though taken from well chosen points, fail to show the outlines of the living animal. I am further indebted to Mr. Blake for many valuable notes on several of the species. Acknowledgements are also gratefully made to the Museum of Comparative Zoölogy for the privilege of studying and recording specimens in its collection, and to various observers whose names appear in the pages following, in connection with notes they have furnished me.

The Whalebone Whales.

The living Cetacea comprise two well defined groups or suborders, the toothed whales or Odontoceti, and the whalebone whales or Mystacoceti. To the former group belong the Dolphins (Delphinidae), the Sperm Whales (Physeteridae), and the Beaked Whales (Ziphiidae). To the latter group belong those that instead of functional teeth have whalebone plates depending from the roof of the mouth. Three families of whalebone whales are currently recognized: the Balaenidae (Right Whales), Balaenopteridae (Finback Whales), and Rhachianectidae (Gray Whale). That the whalebone whales sprang from toothed forms is evidenced by the fact that vestiges of the original teeth are found within the gums of the embryo. Probably both groups are of common ancestry, although this must be very remote in time. In many respects the whalebone whales have become more modified than the toothed whales. Thus they have lost their teeth, developed whalebone or baleen in their stead, have in some genera suffered reduction of the fingers in the skeleton, the sternum and the sternal ribs have nearly disappeared and the true ribs have largely lost their capitular processes. On the other hand they have retained so primitive a feature as a double blowhole, corresponding to the two nostrils, whereas in all living Odontocetes the blowhole is single. They also retain a considerable number of hairs on the head, even in the adult, whereas in the toothed whales, the few vestiges of hairs are early lost.

Four genera of baleen whales are now recognized as occurring in the North Atlantic: Balaena, Eubalaena, Balaenoptera, and Megaptera. The first-named includes only the single species, *Balaena mysticetus*, the Bowhead or Arctic Whale. It is characterized by its enormous head which comprises a third of the total length, and its greatly arched upper jaw with its narrow plates of whalebone reaching fifteen feet in length. This species is typically an ice whale, and follows the edge of the pack-ice in the circumpolar waters of the Arctic Ocean. In former times it was common as far south as Newfoundland and the Gulf of St. Lawrence but is not certainly known from New England (but see pp. 134, 135 for possible records).

Closely related to this is Eubalaena, the Right Whale, characterized by its much shorter head in proportion, and its less arched skull. Both genera have a number of unspecialized characters as compared with the Finbacks (Balaenoptera) including the lack of a dorsal fin, absence of throat folds, the presence of the typical five fingers in the hand, the greater number of ribs that retain a double articulation with the vertebrae, and the relatively considerable size of the vestigial femur or thigh bone. On the other hand the partial fusion of the neck vertebrae, the extraordinary narrowing of the rostral portion of the cranium, and the great convex curvature of this part of the skull correlated with the long whalebone plates are features of high specialization over the conditions seen in other whalebone whales. To these characters

may be added the lack of a distinct coronoid process to the jaw. The two genera are usually grouped in a distinct family, the Balaenidae.

The genera Balaenoptera (Finback Whales) and Megaptera (Humpbacks) are less closely related to the two genera preceding than to each other and are united to form a distinct family (Balaenopteridae). They agree in having the rostral part of the skull broad at the base, and tapering toward the snout, without the great arching seen in Balaena and Eubalaena; the number of fingers is reduced to four, the throat is grooved by numerous longitudinal folds for the expansion of the great gular bag, and there is an adipose fin (often poorly developed in Megaptera) at the lower part of the back. All the neck vertebrae, in addition, are practically free, or at most some of them are slightly fused by the tips of their processes, and there is a prominent coronoid process on the lower jaw. Megaptera presents a curious combination of characters, specialized and unspecialized, as compared with Balaenoptera. Its chief distinctive features are its greatly developed pectoral limb, of extraordinary length, and the loss of acromion and coracoid, the two processes of the shoulder blade. In respect of these points, it surpasses Balaenoptera in specialization. On the other hand it shows a less degree of development in its short body, the small number of throat folds, and the many hairs on the head. The dorsal fin is of somewhat less definite form also.

The third family of baleen whales (Rhachianectidae) is represented by but a single living species, the California Gray Whale (*Rhachianectes glaucus*), confined to the North Pacific.

Whalebone Whales of New England.

Of the four genera of baleen whales known from the North Atlantic, Balaena — with its single species *B. mysticetus*, the Bowhead or Greenland Whale — seems entirely confined to Arctic waters, and though it formerly followed the cold current from Baffin's Bay south into the St. Lawrence Gulf, it is unlikely that it reached New England within historic times. Of the three remaining genera, Eubalaena and Megaptera are represented north of the equator by a single species each, and Balaenoptera is accredited with four. All of these six species have been ascertained to occur within the New England limits. They are seen occasionally in the near-shore waters but more often at a distance of some miles from land; or dead ones from time to time are cast ashore by the tide.

Of these six living species occurring in the North Atlantic Ocean, closely allied if not identical representatives are now known from the South Atlantic and from the Pacific Oceans. Separate names have been given them by naturalists, so that a multiplicity of species is now nominally recognized, where in all probability there is practical identity. The late Sir William Turner, an eminent authority on whales, has lately (1913, 1914) stated his belief that all these species are cosmopolitan, and this indeed seems likely to prove the case. Until this can be

more definitely shown, however, through actual comparison of a sufficient series of measurements and photographs, it is not here taken for granted, and in the synonymy of each species are included those names only that have been given to the North Atlantic whales.

One's first view of a whale at sea is apt to be disappointing (Plate 13, figs. 3–5). Instead of the huge bulk floating lightly on the surface, and spouting a great column of water that divides neatly into two streams in its descent, as pictured in our older books of natural history, one sees a sharp jet of vapour like a puff of steam, has a brief glimpse of a low black object like a floating spar, followed perhaps by a projecting fin or tail and the whale has gone down. A stranded whale is usually an object of much local interest and is heralded in the newspapers with a more or less inaccurate account of its striking peculiarities. The chief matter of moment is its size, of which the largest estimate is the one generally accepted, while various guesses are made as to the species it represents. The following artificial key, based on characters easily observable in a stranded specimen, will serve to identify any of the species known from our waters.

Key for Identification of Stranded Specimens.

1. No fleshy fin at the lower part of the back; breast flipper rather squarish in outline; no longitudinal grooves or folds on throat; whalebone blackish with dark brown bristles on inner free edge.
North Atlantic Right Whale (*Eubalaena glacialis*).

   A fleshy protuberance or fin at the lower part of the back; breast flipper narrow; the throat with longitudinal grooves ..... 2.

2. Breast flipper or pectoral fin very long (one third total length), its fore edge knobbed; folds on throat few (about 14 to 30); dorsal fin low and thick at its base; hinder edge of flukes crenulate.
Humpback (*Megaptera nodosa*).

   Pectoral short, about a tenth or less of total length, its outline not knobbed; throat folds numerous ..... 3.

3. Size small, not over thirty feet in length; a broad whitish band on middle portion of pectoral fin; whalebone plates and their bristles yellowish white ..... Little Piked Whale (*Balaenoptera acuto-rostrata*).

   Size large, over 40 feet, no white band on pectoral, whalebone not entirely yellowish white ..... 4.

4. Color dark gray or bluish gray, with scattered small spots or marblings of white; size large, up to 80 feet; dorsal fin usually small and far back; *whalebone plates including their coarse bristles jet black.*
Blue Whale (*Balaenoptera musculus*).

   Color dark gray above but central area of belly pure white; dorsal fin high and falcate ..... 5.

5. Whalebone plates particolor, streaked vertically with purple and yellowish white, those at the front end of the *right-hand* side all white; bristles on the inner side coarse and whitish.
Common Finback (*Balaenoptera physalus*).

   Whalebone plates entirely black, but their *bristles* at the inner edge very *fine and white.*
Pollack Whale (*Balaenoptera borealis*).

The identification of whales at sea is often a difficult matter, but with careful observation, it is possible under favorable circumstances, to determine the species by noting its characteristic actions. In many cases, however, this is quite out of the question where but a momentary glimpse is had. On the other hand, the whales may be in sight at close range for many minutes,

and give ample opportunity for study. The following attempt at a 'field key' is based mainly on my own notes and may serve in general to identify the large species of the North Atlantic, though unless one has a slight acquaintance with the appearance of living whales, it may, on account of the relative nature of some of the criteria, be somewhat difficult to apply. It should be added that the only other large cetacean of the North Atlantic not a whalebone whale, is the Sperm Whale, a toothed species. It may be easily recognized by its spout, which is rather low, and *directed obliquely forward*. In diving, this whale throws its flukes out of the water, and goes down almost perpendicularly.

Field Key to Whalebone Whales of New England.

1. Flukes of the tail thrown out of water in making the deeper dives.
   - A. No fin at the lower part of back.....North Atlantic Right Whale (*Eubalaena glacialis*.)
   - B. A small fin at the lower part of the back.
     - a. Spout low and rather globular in form.....Humpback Whale (*Megaptera nodosa*).
     - b. Spout high and columnar.....Blue Whale (*Balaenoptera musculus*).
2. Flukes not shown above water in diving; a prominent fin on the lower part of the back.
   - A. Size large, spout high and columnar.....Common Finback (*Balaenoptera physalus*).
     Pollack Whale (*Balaenoptera borealis*).[1]
   - B. Size small, spout low, often hardly if at all visible; a white band on pectoral visible if close at hand.
     Little Piked Whale (*Balaenoptera acuto-rostrata*).

[1] I am unaware of any way of distinguishing this species at sea from the Common Finback.

Eubalaena glacialis (Bonnaterre).

North Atlantic Right Whale.

Plates 8, 9; Plate 11, Fig. 1.

Synonymy.

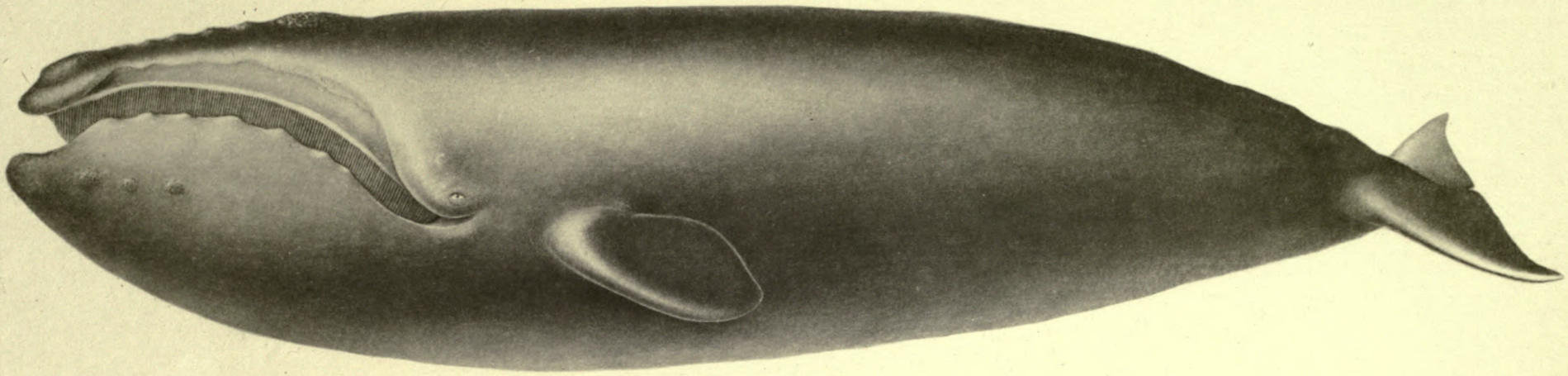
1776. *Balaena glacialis* Müller, Zool. Danicae Prodromus, p. 7 (*nomen nudum*).
1789. *Balaena glacialis* Bonnaterre, Tabl. Encycl. et Méthod. des Trois Règnes de la Nature, Cétologie, p. 3.
1792. *Balaena mysticetus islandica* Kerr, Animal Kingdom, vol. 1, p. 357.
1803–4. *Balaena nordcaper* Lacépède, Hist. Nat. des Cétacés, vol. 1, p. 152 (part), pls. 2, 3.
1860. *Balaena biscayensis* Eschricht, Rev. et Mag. de Zool., ser. 2, vol. 12, p. 229.
1864. *Balaena mysticetus angulata* Gray, Proc. Zool. Soc. London, p. 201, fig. 1 (= *E. glacialis* fide Millais).
1864. *Eubalaena biscayensis* Flower, Proc. Zool. Soc. London, p. 391.
1865. *Balaena cisarctica* Cope, Proc. Acad. Nat. Sci. Phila., p. 168.
1867. *Hunterius swedenborgii* Lilljeborg, Nova Acta Reg. Soc. Sci. Upsala, ser. 3, vol. 6, no. 6, p. 35, pl. 9–11.
1868. *Balaena (Hunterius) biscayensis* Gray, Ann. Mag. Nat. Hist., ser. 4, vol. 1, p. 244.
1868–79. *Balaena byscayensis* van Beneden and Gervais, Ostéogr. des Cétacés, Atlas, pl. 7.
1870. *Balaena britannica* Gray, Ann. Mag. Nat. Hist., ser. 4, vol. 6, p. 200 (based on fossil cervicals from Lyme Regis, England).
1870. *Eubalaena cisarctica* Gray, Ann. Mag. Nat. Hist., ser. 4, vol. 6, p. 391.
1871. *Hunterius biscayensis* Gray, Supplement Cat. Seals and Whales British Museum, p. 44.
1871. *Balaena eubalaena* Gray, Supplement Cat. Seals and Whales British Museum, p. 44 (not Flower, 1864).
1877. *Balaena arentina* Capellini, Mem. R. Accad. Sci. Bologna, ser. 3, vol. 8, p. 3.
1890. *Balaena euskaricnsis* Rial, La Ballena Euskara, Memoria del esqueleto de esta especie, etc., San Sebastian, p. 3.
1890. *Balaena bizcaycnsis* Rial, La Ballena Euskara, Memoria del esqueleto de esta especie, etc., San Sebastian, p. 17.
1900. *Eubalaena glacialis* Kükenthal, Fauna Arctica, vol. 1, p. 207; J. A. Allen, Bull. Amer. Mus. Nat. Hist., 1908, vol. 24, p. 310.

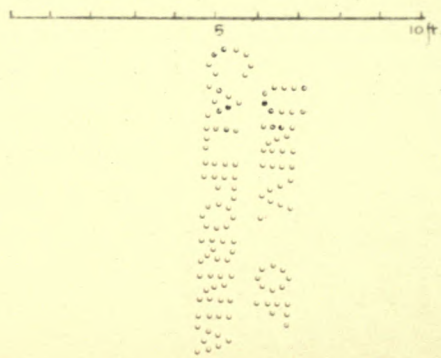
History and Nomenclature.

According to Dr. J. A. Allen's (1908) excellent review of the history of this whale it was first introduced into systematic zoology by Klein, in 1741, who gave the varietal name *borealis* to the Nordkaper of Zorgdrager, supposing it to be a variety of the Arctic Bowhead. Brisson, in 1756, again named it (*Balaena islandica*), and gave its salient points of distinction from the latter. Linné did not differentiate between the two species, but Bonnaterre, in his Tableau Encyclopédique, 1789, recognized the smaller Right Whale as *Balaena glacialis*, founding his description chiefly on Brisson. The name *glacialis* is somewhat inappropriate, however, for this whale frequents the northern waters during only a portion of the year. Under the name *Balaena biscayensis*, Eschricht (1860) recognized the Right Whale of the eastern North Atlantic

PLATE 8.

North Atlantic Right Whale (*Eubalaena glacialis*), adult male. Drawn by J. Henry Blake, from measurements taken by him, of the specimen caught off Provincetown in 1895.





NORTH ATLANTIC RIGHT WHALE—male.

HELIOTYPE CO., BOSTON

UNIV. OF
CALIFORNIA

as a distinct species, and this name has long been current. Cope in 1861 described a specimen from the Western North Atlantic, taken in Delaware Bay, as *Balaena cisarctica;* and other specimens have been described as *Balaena tarentina* and *B. euskariensis.* But there is now no reason to suppose that those of the opposite sides of this ocean are specifically different, as True (1904) has well demonstrated. It was not until 1898 that True revised the nomenclature of the whalebone whales of Linné's Systema Naturae, and established the fact that Bonnaterre's *Balaena glacialis* is the earliest name that can be satisfactorily identified as applying to the present species. In 1908, Dr. J. A. Allen formally reinstated Gray's genus Eubalaena and (p. 307) defined it as follows, in comparison with true Balaena.

"*Eubalaena.*— Head and body relatively long and slender, with the head forming about one fourth of the total length; skull much less arched, and the baleen about one half shorter than in *Balaena*, and also much thicker, not so smooth, and with a coarser fringe." The type species of the genus is *Balaena australis* of Desmoulins. It is currently supposed that this, the Right Whale of the Southern Ocean, is different from that of the North Atlantic, and that the form occurring in the North Pacific is again distinct from either. The differences between these three (or possibly four) have not yet been clearly formulated owing to the imperfect state of our knowledge.

Two other names have been founded on fossil remains of this whale of comparatively recent age. Lilljeborg (1867) described as *Hunterius svedenborgii* sundry vertebrae and a scapula which appear to be identical with those of *Eubalaena glacialis*, though the scapula is slightly more narrowed than usual.

Gray, in 1870, described certain fossil cervical vertebrae from Lyme Regis, England, under the name of *Balaena britannica*, but these are now believed to be identical with those of the North Atlantic Right Whale.

The type locality of the Nordkaper, as given by Bonnaterre, is "les mers du Nord, près des côtes de Norvège & d'Islande."

The etymology of the Latin name is: *eu*, well or typical, and *balaena*, a whale, hence the true or right whale; the specific name *glacialis* (pertaining to the ice), was given through its having been supposed to be an arctic species.

Vernacular Names.

To distinguish it from the supposedly allied species of the North Pacific and of the southern oceans, our species is termed the North Atlantic Right Whale. The word 'whale' itself, from the Old English *whal*, Anglo-Saxon *hwael*, is from the same root as our word 'wheel' and expresses the forward rolling movement of the animal when swimming. The term 'Right' Whale arose with the early whalers, and served to distinguish this and the Bowhead of the Arctic

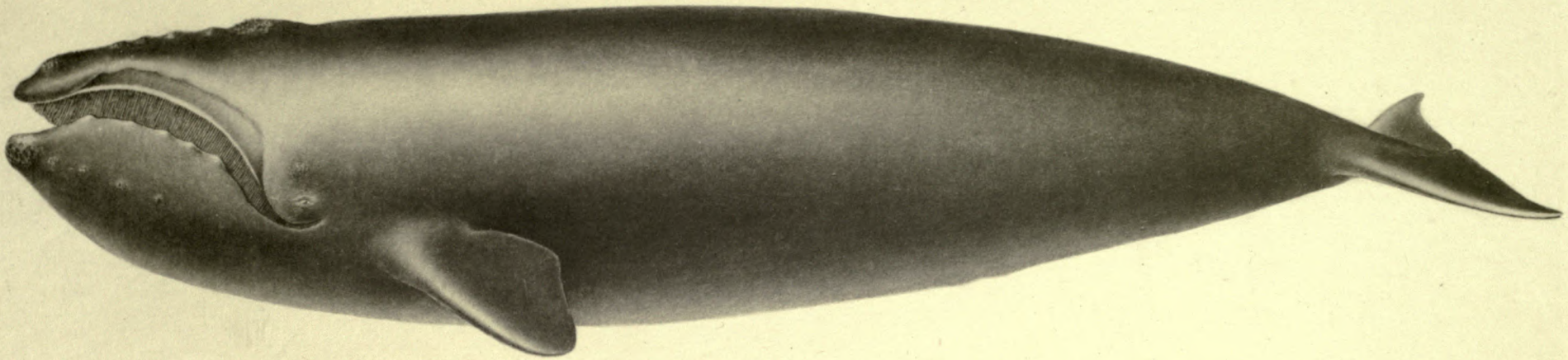
from the Finbacks and the Humpback, which were far less valuable and more difficult of capture and therefore not the right species to pursue. The baleen or whalebone of these latter species was until very recently, not considered fit for use, so that the Right Whales alone were looked to for this commodity, hence the term 'Whalebone Whale,' noted by Dudley as applied by the New England whalers to the present species. The name 'Seven-feet-bone' Whale, mentioned by St. John de Crèvecoeur, had reference to this maximum length of the baleen, in contrast to the twelve- or fifteen-foot plates of whalebone produced by the Bowhead. On account of its prevailingly black color it is also called Black Whale (in Danish, 'Svarthval'). The term 'Serag Whale' is to this day applied by the fishermen of the New England coast to small examples of this species. It signifies a small or emaciated individual. Dudley applied the term to one of the Finner Whales, to indicate a distinct variety. Sundry other names have been given to this species by the European whalers. Thus the Icelanders call it 'Sletbag' (or smooth back) from the lack of a dorsal fin; the Dutch whalers, who pursued them in summer off the North Cape of Norway, knew it as the 'Nordkaper' or 'Noortkaper.' In scientific parlance it has been called 'Baleine des Basques,' the Biscay or Basque Whale, founded on the *Balaena biscayensis* of Eschricht, then supposed to be a distinct species. This whale was long pursued by the Biscayne whalers, who followed it even to the Banks of Newfoundland, but their name for it appears to be 'Sardaco Baleae' (meaning a whale that goes in schools) which is rendered into French as 'Sarde' or 'Sarda.' By the Germans it is called Glattwal or Smooth Whale in allusion to its lack of a dorsal fin and throat folds.

Description.

Form.— Body comparatively short, thick and stout, tapering towards the tail, to form a laterally compressed pedunele — the 'small' of the whalers — whose dorsal profile is sometimes irregularly knobbed. The head is enormous, from a fifth to a fourth of the total length, the upper jaw curved in an arc, the rostrum narrow, and fitting into the depression between the lower lips. The bony rami of the jaws are broadly bowed outwards on each side, and support the great fleshy lips which project upward so as to enclose the upper jaw between them when the mouth is shut. In side view the lower jaw is roughly semicircular in outline, with some half dozen large irregular scallops along its dorsal margin. Near the end of the muzzle is a broad cushion or excrescence, termed the 'bonnet,' of oval outline, and commonly much infested by parasitic crustaceans. The use of this 'bonnet' is unknown. By some it is believed to be due to the presence of the parasites but it is found equally in young whales and is certainly of natural origin. It is possible that it serves as a bumper. Its surface appears much worn or eaten away so as to resemble a bit of furnace slag. A somewhat similar large roughened excrescence is present anteriorly at each side of the lower jaw, and back of each are a few smaller

PLATE 9.

North Atlantic Right Whale (*Eubalaena glacialis*), immature female,— a "scrag" whale. Drawn by J. Henry Blake from measurements made by the writer, of the Provincetown 1909 specimen. Note the relative shortness of the head compared with that of the adult male shown on Plate 8.



NORTH ATLANTIC RIGHT WHALE—immature female.

HELIOTYPE CO., BOSTON

swellings of like nature. These larger swellings are sufficient to give the lower jaw a nearly truncate or square front, though there is a slight emargination at the middle line. In the Provincetown whale of 1909, there were four other roughened areas along the ridge of the upper jaw, the largest not far in advance of the blowholes. The lower jaw is slightly the longer.

The blowholes or external nares are situated at the vertex of the head, slightly in advance of the angle of the mouth. They are two slits one on each side of the middle line, rather wide apart, but converging, anteriorly. In the 1895 male specimen they were 8 inches long, in the 1909 female 6.5 inches, and 4.5 inches apart anteriorly. Their outline from above is gently convex toward the midline (text-fig. 10, p. 274).

The eye is slightly protuberant, and placed low down, a little above the extreme posterior corner of the mouth.

The pectoral fins are of characteristic outline, and inserted below the level of the corner of the mouth. The anterior border is very slightly convex; the posterior margin is the shortest and the fin is broadest at the level of this posterior corner, where it is obliquely truncate.

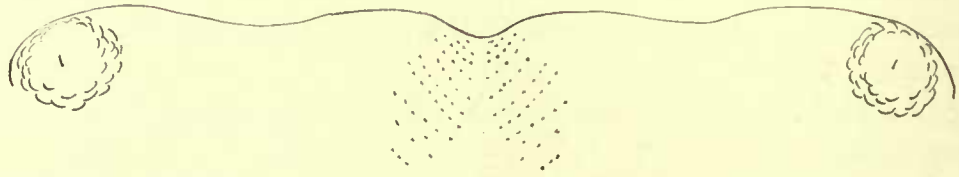
The flukes are relatively broad in their transverse diameter; their combined spread is about four times the greatest basal width. There is a distinct median notch some six inches deep at the posterior border.

The ear is a mere hole or pit externally, about large enough to admit the end of a parlor match. It is situated somewhat behind and below the level of the eye.

Color.—As the term 'Black Whale' indicates, the skin is commonly a deep ebony black throughout. The gum, bordering the inner side of the entire upper jaw, is white, making a contrasting line at the base of the whalebone plates, which also are black.

Variation from this coloring is caused through the occasional presence of white patches of greater or less extent, usually on the ventral surface. In a specimen taken at Amagansett, Long Island, there were "numerous milk-white patches varying in diameter from two to fourteen inches" on the flukes, pectoral limbs, and the region around the genitalia. The spots on the flukes were mainly along the posterior border of the extremities on both surfaces as narrow streaks or patches. The pectorals were strongly marked with white in large patches, particularly on the inferior surface along the posterior margin (Andrews, 1908, p. 172). A newspaper photograph of the whale killed off Cape Cod in 1895, shows it to have been 'white-bellied.' The throat from the symphysis back nearly to the pectorals was white, and thence the white area tapered posteriorly well on to the belly, its outline somewhat irregularly blotched, and with a few scattered black spots. Collett (1909) who has had opportunity of examining some numbers of this species killed in the waters about Iceland, found that about ten out of fifty specimens were white-bellied, and that in many the white area is somewhat constricted in the middle, and in places, especially towards the sides, thickly dotted with oblong black spots; the pectorals were black in all (see plates with Collett's paper).

Hair.— Although devoid of a hairy covering, the whalebone whales have retained a certain number of hairs in definite places, that possibly serve a tactile function. In the Provincetown 1909 whale that I examined, there were on the upper jaw near the middle of the tip, a few scattered grayish hairs, and on the lower jaw in the region of the symphysis some hundred or more, stiff, projecting bristles about one fourth of an inch long, and arranged in fairly definite rows trending toward the midline at a considerable angle (see diagram, text-fig. 1). In addition



TEXT-FIG. 1.— Diagram to show arrangement of hairs at the chin of the North Atlantic Right Whale.

there were one or two longer bristles of an inch or so, protruding from the great excrescences at each side of the symphysis. Andrews (1908) in the Long Island specimen found about 150 white hairs "between the tip of the snout and the anterior end of the bonnet" and about the same number in the region of the mandibular symphsis.

Baleen.— The whalebone or baleen plates are arranged in two longitudinal series, one on each side of the roof of the mouth. The plates number some 250 on a side, of which the central are the longest. In the 1895 Cape Cod specimen, the longest plate measured 5 feet 6 inches and was 7 inches broad at the base (*fide* J. H. Blake). In the Amagansett specimen the longest plate, exclusive of the bristles, was 6 feet 5 inches (Andrews, 1908, p. 175). In the specimen in the Museum of Comparative Zoölogy taken at Provincetown in 1864 "some of the whalebone was seven feet in length" (J. A. Allen, 1908, p. 322); and True (1904) gives 7 feet 2 inches for the longest recorded American specimen. The color of both plate and frayed bristles of the inner margin is black, but in some specimens the extreme bases of the plates and their bristles (Andrews, 1908) or a few entire plates (Collett, 1909) at the anterior end of the series may be white.

External Measurements.— As stated by Dr. J. A. Allen (1908, p. 321) the largest American specimen yet recorded is the adult female taken at Amagansett, Long Island, Feb. 22, 1907, which measured 54 feet from the tip of the snout to the notch of the flukes. This is exactly the same as given by Collett (1909) for the largest of the Iceland whales of which he had record, and no doubt represents nearly the maximum size. He found further that the females seem to average slightly larger than the males, though this difference is not very marked. Thus of 12 males killed in 1907, the extremes were 43 and 48 feet, and of 12 females, 44 and 49 feet. Andrews (1908) has recorded the measurements of two specimens from Long Island, and those of a few other American specimens are given by True (1904). The only published measurements of a New England specimen are those given by the latter author, supplied him by Mr. J. H. Blake from the 1895 Cape Cod specimen. These with some additions given me by Mr. Blake,

as well as those taken by myself from the 1909 Cape Cod female here follow, together with their reduction to percentages of the total length. It should be stated that Mr. Blake's measurement of this latter dimension is from tip of *lower* jaw to notch of flukes, whereas mine is from tip of *upper* jaw to the same point. The measurements in this and other tables are in English feet and inches to correspond with those given in True's monograph (1904), as well as in meters.

EUBALAENA GLACIALIS.

Measurements of the Provincetown 1909 female.

	Ft.	In.	Meters	Percentage of total length
Tip of upper jaw to notch of tail in straight line	34	9	10.59	100
" " " " " bonnet	1	1	0.33	3.1
" " " " " last plate of baleen	7	8	2.34	22.0
" " " " " corner of mouth	8	2	2.49	23.5
" " " " " eye	7	10	2.39	22.5
Greatest width of 'bonnet' anteriorly	1	1	0.33	3.1
Greatest vertical thickness of lower lip	3	3	0.98	9.2
Transverse width of lower jaw anteriorly	2	8	0.81	7.6
" " " upper jaw "	1	10	0.56	5.2
Axial length of left blowhole		6.5	0.16	1.5
Distance between anterior tips of blowholes		4.5	0.11	1.0
Length of eye opening		3	0.08	0.6
Corner of mouth to anterior insertion of pectoral	2	10	0.86	8.1
" " " " posterior insertion	1	9	0.53	5.0
Anterior border of pectoral from insertion to tip	5	4.5	1.64	15.4
Greatest width of pectoral (from posterior corner)	3	5	1.04	9.8
" " " " at insertion	2	2	0.66	6.2
Posterior border of pectoral	2	3	0.68	6.4
Vertical thickness of pectoral at insertion	1	3	0.38	3.5
Length of mammary slit		7	0.18	1.7
Distance apart of mammary slits anteriorly	1	1	0.33	3.1
" " " " " posteriorly		9	0.22	2.0
Vaginal opening to anus	1	3	0.38	3.6
Anus to notch between flukes	11	10	3.61	34.0
From tip to tip of flukes	11	77	3.53	33.3
Caudal notch to anterior insertion of fluke	3	0	0.91	8.6
Posterior border of right fluke	6	0	1.83	17.2
" " " left "	6	0	1.83	17.2
Anterior border, left fluke, from insertion to tip	6	8	2.04	19.2
Depth of caudal notch		6	0.15	1.4
Breadth " " " posteriorly		8	0.20	1.9
Vertical height of peduncle at insertion of flukes	1	8	0.51	4.8
Half girth of head, from between blowholes, over eye	10	0	3.05	28.8
Ventral distance between anterior insertions of pectorals	6	8	2.04	19.2
Thickness of blubber a yard in front of anus		9	0.23	2.1
" " " near middle of body		6	0.15	1.9

Measurements of the Cape Cod 1895 male (from J. H. Blake).

	Ft.	In.	Meters	Percentage of total length
Tip of lower jaw to notch of tail	42	5	12.93	100
" " upper jaw to corner of mouth	13	0	3.96	30.6
" " " " to blowholes	9	2	2.79	21.5
Greatest vertical thickness of lower lip	8	±	2.44	18.8
Axial length of blowholes		8	0.20	1.5
Distance between posterior tips of blowholes		7	0.18	1.4
Tip of lower jaw to anterior insertion of pectoral	17	0	5.18	4.0
Posterior corner of eye to anterior insertion of pectoral	3	4	1.02	7.8
Anterior border of pectoral from insertion to tip	6	0	1.83	14.9
Greatest width of pectoral (from posterior corner)	2	9	0.84	6.5
Anterior insertion of pectoral to penis	12	0	3.66	28.3
Anus to notch of tail	12	0	3.66	28.3
Caudal notch to anterior insertion of fluke	3	4	1.02	7.8
Posterior border of left fluke (straight line)	6	9	2.06	15.9
Ventral distance between anterior insertions of pectorals	7	0	2.13	16.4
Longest baleen	5	6	1.68	12.9

These measurements and proportions show a rough general agreement but indicate the somewhat more slender build and relatively shorter head of the smaller (female) specimen. Andrews (1909a, p. 274) has given the measurements of a young female 27 feet $9\frac{3}{4}$ inches in total length, taken off Amagansett, Long Island, on December 10, 1908. He points out that the pectorals and the flukes are much larger in proportion than in adult specimens. It is interesting also that in this young whale, perhaps not more than a year old, the 'bonnet' was well developed, and infested with Cyami, as were also the roughened areas on the jaws.

Skeleton.

Skull.— Apparently the only New England skeleton of this species preserved in any museum is that in the Museum of Comparative Zoölogy at Cambridge, taken off Provincetown in April, 1864. This is now mounted and hangs from the ceiling of the main hall. It was studied and measured by Dr. J. A. Allen soon after its reception, and his account of it with illustrations has lately been published (J. A. Allen, 1908). He gives the following cranial measurements, which I have reduced to percentages of the total length of the skull.

Skull Measurements.

	mm.	Percentage
Axial length, occipital condyles to tip of intermaxillaries	3650	100
Occipito-frontal suture to posterior border of occipital condyle	740	20.3
Fronto-nasal suture " " " " " "	880	24.1
Anterior border of nasals " " " " " "	1160	31.7
Length of nasals along outer border	350	9.5

	mm.	Percentage
Length of nasals along inner border	250	6.8
Breadth of nasals anteriorly	330	9.0
" " " posteriorly	330	9.0
Length of maxillary, axial	2780	76.1
" " " on curve of superior external border	3150	86.3
" " intermaxillary	2810	77.0
" " " along dorsal convexity	3260	89.3
Breadth of skull at orbital processes of frontal	2500	68.4
Breadth of skull at zygomatic processes	2325	63.7
" " " " mastoid processes	1590	43.5
Greatest breadth of occipital bone	1090	29.8
Transverse breadth of occipital condyles	240	6.5
Antero-posterior " " " "	285	7.8
Length of mandible, axial	3270	89.6
" " " along external curvature	4000	109.5
Greatest depth	430	11.7
Transverse diameter of condyle	360	9.8
Vertical " " "	370	10.1

The skull of Eubalaena is very characteristic in appearance and highly specialized for the support of the long and narrow plates of baleen through the narrowness of its rostral portion, especially of the maxillary bones from which these blades depend. In addition to the great lateral reduction of these bones, the entire rostrum is strongly arched in side view to accommodate the long baleen plates. This portion of the skull, as seen from the above table is more than two thirds of the total length. The intermaxillaries project somewhat beyond the tips of the more lateral maxillary bones, and the nasals are enclosed between their proximal ends at the base of the rostrum. The nasals are each deeply notched at their free end and form the posterior boundary of the nasal opening. A narrow tongue of the maxillary and the frontal bone are produced postero-laterally and meet a lateral extension of the squamosal bone to form the eye socket, which is further defined by the short thick jugal forming the ventral half of the orbit. The occipital portion of the skull is broad and rounded in outline. Viewed from above the lower jaws bow widely out on either side to support the thick and massive lower lips. They extend slightly beyond the upper jaw. The condyles are large and round, but the coronoid process, though present in the Balaenopterae, is lacking, a further mark of specialization. A large canal is present on the internal side at the base, for the mandibular branch of the facial nerve.

The Provincetown specimen of 1864 had 56 *vertebrae*, namely, cervicals 7, dorsals 14, lumbars 11, caudals 24. Andrews (1908, p. 176) found the same formula in two Long Island specimens, except that one had only 23 caudals. True (1904) records a Long Island specimen in which the formula was C. 7, D. 14, L. 10, Ca. 26 = 57, but the other formula is the more usual.

The cervical vertebrae are, in the adult, more or less completely united into a solid mass. The centra are usually well ankylosed, while the neural spines and the transverse processes are variously united. Thus in the Provincetown 1864 specimen, as described by Dr. J. A. Allen, the spinous processes of the first to fifth cervicals have entirely fused, but the tips of the two remaining are free. Of the transverse processes, those of the atlas are both free, and of the remaining six, that of the second is free on the left side, but on the right side is fused with the transverse process of the third, and all the rest on this side are fused together at their outer ends. On the left-hand side, the third and fourth are fused, at their tips, and the fifth, sixth, and seventh in a second group. This specimen is remarkable for the relatively slight degree of fusion between the atlas and axis.

Sundry measurements of vertebrae are given by Andrews (1908) and J. A. Allen (1908) for American specimens. The neural spines increase in height at the shoulder region and maintain their length well on to the lumbar vertebrae, whence they decline rapidly, at the same time becoming strongly slanted backward. In the Provincetown 1864 whale the 41st is the last vertebra to have this process and the anterior articular processes well developed, and the 45th is the last to have a neural canal. The transverse processes of the lumbars and caudals differ greatly from those of the Fin Whales. In these the processes are broad, thin, and flattened, arising from nearly the whole length of the centrum, regularly expanding distally, and finally terminating in an almost knifelike edge. In Eubalaena on the contrary, they arise from a much smaller portion of the centrum, are oval or elliptical in section, and at the end expand slightly, while instead of coming to a thin edge, they terminate with a truncate elliptical face. These processes are rather long at first but on the anterior caudal vertebrae shorten rapidly and become a mere ridge on the 40th vertebra and practically disappear with the 41st or 42d. The vertical perforation of the transverse process first appears on the 38th (or 39th) vertebra and disappears with the 45th, the last also to have a neural canal. The centra of the 38th to 41st vertebrae or thereabouts are markedly larger than those preceding them, giving greater bulk to the tail, while the 45th is much smaller, and those succeeding dwindle quickly in size, becoming mere rounded ossicles.

Some discrepancy appears in the recorded numbers of the *chevron bones*. There are only nine in the Provincetown 1864 skeleton as mounted, but probably the series is incomplete, as the posteriormost are small and easily lost. Andrews (1908) who carefully dissected these bones from two Long Island specimens found twelve in one, and but nine in the other and younger animal. The fifth was found to be the largest, 11.5 inches long with a keel 8 inches long.

The number of *ribs* is fourteen on each side. The first pair is sometimes double-headed, in which case the extra head articulates with the last cervical and is really a cervical rib that has become fused with the first true rib. It was on this individual peculiarity that Gray

founded his genus *Hunterius*. Holder (1883) records that in the skeleton in the Charleston (S. C.) Museum, the first rib (which was single-headed) had "but one articulating surface, which joins to the transverse process of the first thoracic vertebra." The next eight ribs are joined to the vertebrae by two articulating surfaces, one junction being to the transverse processes, and the other to the bodies of the vertebrae. The remaining five, floating ribs, have one attachment, which is to the [transverse processes] of the vertebrae." The last rib is usually much shorter than those before it. The attachment of the anterior ribs to the sternum is very slight, allowing thus considerable freedom of movement so as to enable the animal to expand and fill its lungs to the utmost capacity when breathing, preliminary to making a dive.

The *sternum* is usually more or less heart-shaped. That of the Provincetown 1864 specimen at Cambridge is decidedly so, and is figured by True (1904, Plate 46, fig. 4) from a photograph. The figure of the same specimen published by Dr. J. A. Allen (1908, Plate 23, fig. A) is from a drawing and shows it of a roughly oval outline, but this must be in reality some other bone. True (1904, p. 258) figures diagrammatically the sternum of a Right Whale killed off Long Island, N. Y., that is roughly cruciform, and which, as he states, so much resembles that of the Finback Whale that "one might almost believe that it did not belong to the skeleton to which it is attached." The sternum in these whales is a bone that has become of less importance consequent to the adaptations to an aquatic life, and hence is subject to more or less imperfect development leading to its reduction in size. The deep median notch is significant of its origin from two lateral portions that in most land mammals fuse very early in life.

The outline of the *scapula* (text-fig. 5, p. 191) is highly characteristic. The vertebral border is evenly and roundly convex. The anterior border is very nearly straight or faintly concave almost to the antero-dorsal corner where it becomes slightly convex. The posterior border is straight for about one fourth its length and then becomes evenly concave from that point to the glenoid cavity. The ridge of the scapular spine is low and begins nearly half-way to the glenoid border, near the anterior edge of the shoulder blade. The acromion process is large and produced forward as a broad tongue. The infraspinous portion of the scapula therefore includes nearly its entire lateral aspect. In two specimens from Long Island, N. Y., Andrews (1908) found the right scapula the larger in each. There are no *clavicles* in the Cetacea.

The *humerus* is short and thick with a very large rounded head. Distally it has two articulating surfaces that slant in toward the main axis so as to meet at an angle. The anterior articulates with the radius, the posterior with the ulna, forming thus an elbow joint that is without power of flexion. The ulna and radius are of somewhat similar shape, much flattened, short and thick, expanded distally. The ulna resembles that of the Humpback and differs from that of Balaenoptera in lacking the basal expansion at the outer side, which in the latter genus overlaps the end of the humerus.

The *carpus* of this whale is still imperfectly known. There is apparently some variation

in the number of ossicles that may be present, imbedded in the mass of cartilage between the arm bones and the metacarpals. Holder (1883, Plate 12) in his figure of a Long Island skeleton shows no less than eight carpals in addition to a pisiform bone, the latter a prominent cylindrical knob at the ulnar margin. There is no probability that their relative positions are correctly delineated in this figure. Manigault was unable to discover any in the Charleston, S. C., whale, though it is probable that they were lost or destroyed in maceration. Andrews (1908) in the two Long Island whales, found five distinct rounded ossifications in the right carpus and four in the left in one specimen; four in the right and three in the left in the other. The homology of these bones is yet to be thoroughly worked out. There appear to be three bones in the proximal row corresponding to the radiale, intermedium, and ulnare, but those of the distal row are not so readily homologized. No doubt in young or immature specimens these ossification centers are so poorly developed as to be hardly discernible in many instances.

The number of *metacarpals* and *phalanges* in the several fingers is best determinable by careful dissection of the pectoral limb itself, rather than from mounted specimens. This method was used by Andrews (1908) who found in a Long Island specimen, the following (Roman numerals signify the several digits, Arabic numerals the number of phalangeal pieces): I 1, II 4, III 5, IV 4, V 3. While this formula is undoubtedly correct, the mounted specimens in American museums as cited by True (1904, p. 261) show a possible variation, which if actually present, indicates an extra phalanx at times in case of digits I, and V or one less in case of digit IV.

A peculiar interest attaches to the vestiges of the *pelvic girdle* and *hind limbs*. These are found imbedded deep in the flesh nearly dorsal to the anus. Two small and somewhat crescentic bones with their concavity inward, and placed parallel with each other on the opposite sides of the body, are the remains of the pelvic girdle. In the Provincetown 1864 specimen the length of one of these bones is 220 mm., its greatest width where it expands near the posterior end, 70 mm. The anterior two thirds is expanded, the posterior third cylindrical. In a Long Island specimen the right pelvic bone was 450 mm. long, the left 435. "Each had attached to it a vestigial femur,— a flattened bone, 135 mm. long, 58 mm. wide, and 10 to 28 mm. thick, parallel-sided for about half the length, with one entire side straight, the other sloping at an obtuse angle" (Allen, 1908, p. 329). These bones are figured by Dr. J. A. Allen. That these vestiges of the pelvis still remain is probably because of their being of use for the attachment of certain small muscles, as the crus penis in the male. Abel (1908) in his monograph on the pelvic bones of Cetacea gives two excellent figures of these elements in place, from an Icelandic specimen. One is more nearly an isosceles triangle than the other, but in both the apex of the triangular bone is to the exterior. The anterior portion corresponds to the ilium, the posterior to the ischium. Just behind this apex is a shallow acetabular cavity, into which fits the head of the vestigial femur, which is a short cylindrical bone, with the head slightly constricted off and with a distinct postero-lateral ridge, representing the great trochanter. Attached to

the distal end of the femur is a ligamentous rod, which probably represents the tibia. In the Greenland Whale or Bowhead this tibia is slightly bony.

Sir William Turner (1913) has very recently described for the first time an *os penis*, hitherto unknown among baleen whales. In an adult specimen it was 12.75 inches long, and somewhat cylindrical.

Appearance and Actions.

It has not been my good fortune to observe this species in life. Collett (1909) and others agree that "it is fond of lying quietly on the surface of the water" and at such times it is not unlikely that it sleeps. I have elsewhere mentioned (p. 146) an adventure with such a sleeping whale in Cape Cod Bay which ended disastrously to one of the *Mayflower's* crew in 1620. When at the surface it swims slowly, with its blowholes above water. "As a rule," says Collett, "it blows five or six times in succession, and then remains under water for from ten to twenty minutes," going down with a nearly perpendicular dive, in which the flukes come quite up out of the water. Millais (1906) says on the authority of a whaleman, that it blows from ten to twelve times, and is then gone for ten minutes. It will sometimes rise partly from the water, but apparently has not been seen to leap clear. When rising to the surface to blow, the head comes much farther out than in the Balaenopterae, and as it swims in calm water, the top of the head and the back are visible, but owing to the arching of the head, there is a depression at the neck, so that water appears between these two portions, whereas in the Balaenopterae the convexity of head and back are practically continuous (Buchet, 1895). The absence of a dorsal fin and the appearance of the flukes in diving are further field marks. When not alarmed its rate of speed is said to be about four miles an hour, a leisurely pace.

Spout.

The spout of this species is said to be about fifteen feet high, and to form a comparatively thicker column than that of the Common Finback. In nearer view it is seen "to be distinctly formed of two jets falling to different sides" (Collett, 1909, p. 96). The blowholes are situated rather farther apart and are more divergent than in the Rorquals so that the double source of the spout is more apparent. Buchet (1895) who seems to have had some first-hand knowledge of this species in the Iceland seas, says that the spout is thin and difficult to detect.

Schools.

Right Whales do not travel in large schools. Usually not more than two or three are found together, and these appear to be often a pair, or a pair with a calf. Where food is abundant, a considerable number may gather; and though sometimes spoken of as schools, such gatherings must be incidental rather than the result of purposeful association. In the

northern seas, Collett mentions that among the Hebrides the whales were attracted to certain favorable spots, sometimes to the number of at least one hundred, or even more and that they stayed a longer or shorter time, then disappeared. On our New England coasts and off the southern shores of Long Island, where they are merely in transit, there are rarely more than a few together. Thus off Wainscott, Long Island, about the middle of May, 1826, two Right Whales, one a very large individual, were pursued by the local whalemen, and shortly a third, said to be a 40-barrel calf appeared and was captured. Apparently these three were in company. At the same time a fourth was killed off Westhampton, L. I., so that perhaps all four may have constituted a small party moving north together (see Sagharbour Corrector, May, 1826). Five Right Whales were killed off Long Island, between South Hampton and East Hampton one day about the middle of April, 1847, indicating the presence of a school of several, at least five (Nantucket Inquirer, vol. 27, no. 47, April 21, 1847).

Two were seen together in late November, 1864, off Nantucket, perhaps a pair, though there is nothing to indicate this (Nantucket Inquirer, vol. 45, no. 1, Nov. 30, 1864). In April of 1886, a "small school" is said to have appeared off Tuckernuck Island, Mass., and in the course of a few days, three were killed, but how scattered this company was, is not indicated.

Van Beneden (1885) mentions a note sent him by J. B. Holder telling of the capture of four from a school of six, one a young one, on the American coast.

Disposition.

The whalers at the Hebrides in late years have killed a number of these whales, and according to Collett (1909) they find them not timid, but on the whole easy to approach. Here the bomb-harpoon is used, after the Norwegian method. If a vital spot is struck the whale soon dies; but if only wounded, "it becomes very violent in its movements, to the no small danger of the boats, although it does not attack them; it plunges round in the water like a ball and often gets the line wound several times round its body. Notwithstanding the thick build of its body, it is able to bend it until the head nearly meets the flukes" (Collett, 1909, p. 96).

Although the Right Whale seems to be in general a most peaceful and inoffensive animal, instances are not wanting, to show that it is capable of inflicting damage upon its pursuers by rising beneath their boat, smashing it, and throwing its crew into the water. Whether such mishaps are accidental or whether the whale intentionally makes the effort to rid itself of the pursuing boat is problematical. The Sperm Whale is unquestionably the aggressor at times, and it seems not unlikely that the Right Whale may also on occasion turn against its tormentors. A few such cases are here recorded.

In Swift's History of Old Yarmouth, Mass., (1884, p. 136) is the brief record that in the

year 1716, "Mr. Jonathan Howes was killed by a whale which he attacked in a boat." This whale was probably Eubalaena as that was the species commonly sought by the shore whalers in those days.

Douglass, writing in 1755, clearly indicates the difference between the Arctic Bowhead Whale, and the southern Right Whale in size and yield of oil or bone. He adds, that the latter species "are wilder, more agile and do fight."

Mr. J. Henry Blake has most kindly written out for me an account of the capture of a Right Whale off Plymouth in April, 1864. It had been seen by people at Provincetown, and Capt. Robert E. Smith had set out in pursuit. At length its spout was descried, and the whale itself made out lying quietly at the surface. Two boats hastened toward it, and Stephen T. Nickerson, captain of the foremost boat put in the first harpoon. The whale commenced rolling in the water, and shortly received a second harpoon from the other boat. It then settled out of sight but shortly came to the surface striking the bottom of the second boat with its 'bonnet' (or forward end of the upper jaw), directly under the feet of a boy who was pulling the leading oar. So great was the impact that a hole was broken in the bottom at this point, the boat tipped on end, and its crew thrown into the water. They managed to cling to their overturned craft till picked up by their vessel, while the second boat shortly lanced and killed the whale. That the bottom of the boat should have been broken by the impact with the tip of the whale's head may be evidence that the animal had risen in a rather more vertical position than when merely spouting, and with more than usual force. The incident shows that the whale manifested some purpose and determination in its action and points to the possible use of the 'bonnet' as a sort of bumper for offensive purposes, akin to the horn of the rhinoceros.

The Nantucket Inquirer of May 10, 1854 (vol. 34, no. 55) mentions a '30-barrel' Right Whale, that was struck off Southampton, L. I., on April 29th, of that year, and though mortally wounded, showed much fighting power. It eventually turned upon its pursuers, stove in their boat, and threw them all into the sea, severely injuring Capt. Albert Rogers, and several others of his crew. Other boats engaged in the chase, speedily came to their rescue and picked them up. The whale meanwhile made off, spouting blood.

Major Edgar A. Mearns sends me a note from an interleaved almanac, dated at East Greenwich, R. I., November 17, 1759, which doubtless refers to a fatal encounter with a Right Whale. The account reads: "This day sailed poor Ebenezer Simons, of Swansey, and off Man Tongue [Montauk] Point, end Long Island, was, about 3 P. M., struck by a whale, which stove their vessel, so that she sank immediately. Out of seven men two were saved. Master and mates and 3 men lost" (Newport Hist. Mag., 1880, vol. 1, p. 123).

The endurance of the Right Whale, while not equal to that of the swifter-moving Rorquals, is yet considerable. Thus a '60-barrel' Right Whale that was struck off Nantucket

in April, 1886, at 7.30 in the morning, headed out to sea, towing the boat with six men, for seven hours; during this time the men were only once able to haul up near enough to dart in a lance, but even then the whale kept 'milling' about in so lively a manner that they were unable to reach a vital spot. Finally they were obliged to cut the line as a dense fog had settled, and they were far from land. Five hours' hard pulling brought them back to Muskeget (Nantucket Journal, vol. 8, no. 30, April 22, 1886).

Food.

The food of the North Atlantic Right Whale consists in large part at least, of the small crustaceans, *Thysanoëssa inermis*, a schizopod, and *Calanus finmarchicus*, a smaller copepod, which often are found in immense numbers on and near the surface, so that at times they even tinge the water with red. Paul Dudley, in his interesting essay on the New England whales, wrote that the young Right Whales are suckled for the first year, but that they then, "as is generally supposed, live upon some ouzy Matter, which they suck up from the Bottom of the Sea,. . . .and yet an experienced Whaleman tells me, that he has seen this Whale in still Weather, skimming on the Surface of the Water, to take in a Sort of reddish Spawn, or Brett, as some call it, that at some Times will lie upon the top of the Water, for a Mile together." This "reddish Spawn" is none other than the masses of these small crustaceans, commonly known even now as 'brit,' or by the Norwegians as 'krill.' The Calanus is minute, only four millimeters long, but *Thysanoëssa inermis* is longer, about 16 mm. or five eighths of an inch. In still weather, as observed by Dudley's informant, they may gather at the surface of the sea in enormous multitudes, but if the surface is rough they seek the depths. Collett (1909) who has recently had a very favorable opportunity to study the Right Whale at the Iceland whaling stations and in the Hebrides, says that their food is exclusively these pelagic crustaceans, which they take in as they pass back and forth in the plankton currents. Buchet (1895) from observations at the same locality, corroborates this statement, though it is still uncertain which of the two species forms the bulk of the food. The copepod is undoubtedly the more abundant, and is more widely distributed; the schizopod is larger and seems to be an animal of more northern waters. No doubt the movements of the whales are largely regulated by the presence of these crustaceans on which they feed. Both species are abundant in the northern seas during summer, but there seems to be little record of their appearance in the winter months. In Vineyard Sound *Thysanoëssa inermis* is known to have been "in two successive years recorded as abundant in January." [1] Bigelow (1914) did not find it in July and August in the Gulf of Maine, which may indicate that it is present in our waters during the colder part of the year only.

[1] Sumner, Osburn and Cole. Bull. U. S. Bur. Fish., 1913, vol. 31, p. 663.

There seems to be no good evidence that fish forms any part of the diet. C. G. Zorgdrager quotes Frederick Martens' Voyage to Spitzbergen that over a barrel of herring were taken from the stomach of a Nordkaper captured at Shetland, but this evidence may be questioned, and it is more than likely that some one of the Finner Whales was meant.

Stranding.

It rarely happens that the Right Whale becomes stranded on our shores, except through some unusual chance. The Nantucket Inquirer and Mirror (vol. 57, no. 20, Nov. 11, 1876) gives an account of a "forty-barrel Right Whale" that was discovered in early November, 1876, aground on the bar near Capaum Pond, Nantucket, where it had evidently ventured in too close to the shore. Preparations were made to kill the whale: a boat was manned, harpoons procured, and the party set forth to effect the capture, but by this time it had succeeded in freeing itself and though pursued for eighteen miles, eventually escaped.

Breeding Habits.

Very little is definitely known concerning the breeding habits of the Right Whale in the North Atlantic. Collett (1909) has recently furnished some new observations made in the Iceland Seas, where of late years a number of these whales have been taken. He states that "three specimens were observed just before copulation on the 7th July, 1908. A female was lying on her back, and on each side of her lay a male with extended genital member, when the vessel came upon them and secured the female." Of twelve females killed in the Iceland Seas in the summer of 1907, Collett states that each contained a foetus, and these were all of nearly the same size, one to one and a half meters in length, the largest with the rudiments of baleen. Of the eight females killed in 1908, none was gravid, which may indicate either that the gravid females go in separate schools, or that they have young but once in several years. If copulation usually takes place in summer, the period of gestation is probably at least nine months or thereabouts, for the young are not born until late winter.

On the New England coasts, I have found no record of young Right Whales in the *late* months of the year, indicating that the young have not yet been born. Most of the records of young Right Whales here refer to cows with their single calves, seen or taken in the latter part of winter or spring. In 1697, Cotton Mather speaks of the capture of a cow Right Whale near Yarmouth, Mass., that was accompanied by a calf twenty feet long. On April 10, 1800, a calf was captured off Nantucket, from among a small number of this species, and made but sixteen barrels of oil. Off eastern Long Island, about the middle of May, 1826, a calf was killed, and three adults. About the first of March, 1870, a Right Whale with a calf appeared in Provincetown Harbor, but both eluded their pursuers. Off eastern Long Island, a large

cow with her calf, was unsuccessfully pursued about the last of March, 1884. Off Cape Cod, in the first week of June, 1888, a cow and calf were found together and both were killed with bomb-lances. Other instances might be multiplied of the occurrence of Right Whales with calves in the spring months on our coast. Unfortunately there are few data available as to the size of the smallest of these calves. That mentioned by Cotton Mather as but 20 feet in length must have been very young indeed, perhaps but recently born. The only instance I have found of the capture of a gravid Right Whale on the east coast of the United States, is that recorded by Dr. G. E. Manigault,[1] who says that "a female, ready to give birth to her young, was secured off the harbor of Port Royal, S[outh] C[arolina] in February, 1884, and towed inside, when the operation of cutting up was done at leisure. This specimen was about sixty feet in length, and, although I did not visit it, I feel certain, from descriptions, that it was a *B. biscayensis*. The calf, upon measurement, proved to be 20 feet in length." The latter measurement corresponds closely with that recorded by Mather for the calf killed at Cape Cod (see above).

The evidence seems to show that in case of the Right Whale, copulation probably takes place in summer. Adults with foetuses from one to one and a half meters long are taken in the Iceland Seas in summer. The young are born in winter (January and February) while the whales are in the warmer waters to the south, and appear in spring with their mothers on the New England coasts. Probably the majority of those born on this side of the Atlantic are brought forth south of New England. The length of the new born whale is probably about twenty feet. Collett (1909) notes that the smallest of these whales killed during the summer in the Iceland seas were 31, 36, and 37 feet long respectively (9.45, 10.9, and 11.2 meters). It can be merely conjecture whether these are young less than a year old. The young one recorded by Andrews (1909a) from Long Island in December, 1908, was but 27 feet $9\frac{3}{4}$ inches long and so perhaps a young of the preceding spring on its first journey south. It is certain, however, that small whales up to forty feet, probably born at least a year earlier, are found off our shores in spring, sometimes accompanying a pair of larger whales. Such a one (40 feet 3 inches long) is that described by R. C. Andrews (1908) as captured at Wainscott, Long Island, N. Y., on February 22, 1907, accompanied by an adult female 54 feet long. Probably the young may accompany their parents for a year or longer. Paul Dudley, whose classic account of the whales of New England, prepared in 1725, seems to be founded largely on accurate observations, says: "This Fish, when first brought forth, is about twenty Feet long, and of little Worth, but then the Dam is very fat. At a Year old, when they are called Short-heads, they are very fat, and yield to fifty Barrels of Oil, but by that time the Dam is very poor, and termed a Dry-skin, and will not yield more than thirty Barrels of Oil, tho' of large Bulk. At two Years old, they are called Stunts, being stunted after weaning, and will then yield generally from

[1] Manigault, G. E. Proc. Elliott Society, Charleston, S. C., 1886, vol. 2, p. 104.

twenty four to twenty eight Barrels. After this they are termed Scull-[School-] fish, their Age not being known, but only guessed at by the Length of the Bone in their Mouths." From this it is apparent that the whalemen believed the young accompanies its mother for at least a year, and is weaned when between one and two years old. A single young is commonly produced at a birth.

Parental Care.— The attachment of the cow whales for their young is attested by the whalers, who generally fasten to the calf first, for the mother will not desert it, and so both are often killed.

Such was the case with the Right Whale encountered off Cape Cod about the first of June, 1888, whose calf was first harpooned and killed, while the cow, refusing to leave her offspring, circled around and around until she succumbed after nine bomb-lances had been shot at her (Nantucket Journal, vol. 10, no. 36, June 7, 1888). Precisely similar were the actions of a Right Whale, which with her young calf, was pursued off the Spanish coast in the Bay of San Sebastiano in January, 1854. The young whale was killed and towed into the bay, followed by its mother, who in her distress circled about the whalers, and even attempted to rescue her offspring by clasping it with the pectoral flipper and trying to drag it away. Finally with a blow of her flukes she broke the lines and, according to the account, succeeded in carrying off her calf. It was picked up next day, however, by a passing vessel and brought back to the harbor, still followed by the old whale. This calf measured but 7.56 meters (24 ft. 9 inches) and no doubt was of tender age.

Occurrence in New England Waters.

Former Abundance.— At the time of the settlement of New England, and for nearly a century thereafter, Right Whales were present in considerable numbers in the shallow waters of the southeastern coast during the late fall, winter, and spring. How abundant they were at this time it is difficult now to estimate. In Cape Cod Bay, the voyagers on the *Mayflower*, in December, 1620, found them daily "playing hard by." Higgeson of Ipswich, in 1629, tells of the "great store of whales, and crampusse." Other writers of the period give similar expressions of their numbers. At the close of the seventeenth century, after nearly seventy-five years of relentless persecution they must have become much less common. Yet, on January 27, 1700, Wait Winthrop[1] of Boston, writes to his brother Fitz-John, that "the winter hath bin so favorable that they haue killed many whales in Cape Cod bay; all the boates round the bay killed twenty nine whales in one day, as som that came this week report; as I came by when I was there last, one company had killed thre, two of which lay on Sandwich beach, which they kild the day before, and reckned they had kild another the same day, which they expected would driue

[1] Coll. Mass. Hist. Soc., 1892, ser. 6, vol. 5, p. 55.

on shore in the bay." Twenty-nine Right Whales in a single day implies a large number in our near-shore waters. Probably this great catch was somewhat exceptional, however, for already they were rapidly diminishing. At Nantucket, Macy tells us that the greatest number ever killed in a single day was eleven, and that, in 1726, the catch for the entire season was eighty-six, a record which was not equalled there before or since. This first quarter of the eighteenth century with the killing out of the whales, marked the decline of this fishery in New England waters, so that we must suppose Higgeson to have spoken truly when he wrote of the "great store" to be seen a hundred years previously.

Seasonal Occurrence.— Paul Dudley, of Massachusetts, wrote of the Right Whale, in 1725, that in the fall of the year they "go Westward, and in the Spring they are headed Eastward..... The true Season for the right or Whalebone Whale, is from the Beginning of *February*, to the End of *May*." [1]

Lord Cornbury, in a letter of July, 1708, says of the whalers at Long Island, New York: "About the middle of October they begin to look out for fish, the Season lasts all November, December, January, February, and part of March." [2]

For a more exact determination of the seasons when the Right Whale was present on the New England coasts, all the records with dates, that have been obtainable, are listed in the following pages, and a summary table is added. Among these records, chronologically arranged, are included a number from the Nantucket Inquirer that refer to eastern Long Island, New York, but which are here brought forward not alone on account of their value in the present connection, but also to make them available to those who are unable to consult that journal. The Nantucketers of the past century were a race of whalemen so that the reports there given may be rather certainly accepted. The Right Whale and less often the Humpback were the only species regularly hunted in our waters until the introduction of more deadly apparatus than the hand harpoon, so that it may usually be assumed that when "whales" are mentioned in the old accounts as seen or pursued, the Right Whale is the species intended. Especially is this the case, since Finbacks or Humpbacks are usually so designated. Most of such indefinite records are nevertheless omitted from the reckoning.

1605.— Rosier, in his relation of Waymouth's voyage to the coast of Maine, speaks of seeing, on May 14th, when off what is now Sankoty Head, Nantucket, "many whales, as we had done two or three daies before."[3] The species of whale is not indicated, but some may have been Right Whales.

1620.— At the time of their arrival at Cape Cod, in late December, 1620, the Pilgrims found whales in numbers about the bay. The oft-quoted journal of Bradford and Winslow,

[1] Phil. Trans. Roy. Soc. London, Abridged, 1734, vol. 7, pt. 3, p. 426–427.
[2] Documents relative to Colonial Hist. N. Y., 1855, vol. 5, p. 59.
[3] Coll. Mass. Hist. Soc., 1843, ser. 3, vol. 8, p. 156.

relates that "every day we saw whales playing hard by us; of which in that place, if we had instruments and means to take them, we might have made a very rich return, which to our great grief we wanted. Our master and his mate, and others, experienced in fishing, professed we might have made three or four thousand pounds worth of oil. They preferred it before Greenland whale-fishing, and purpose the next winter to fish for whale here." [1] This was off the present-day Truro. It is significant that there were on board the *Mayflower*, persons "experienced in [whale] fishing," who at once saw that these whales that daily came about the vessel, were of the sort that yielded profit in oil and whalebone — hence, Right Whales. No doubt the men "preferred it before Greenland whale-fishing" because of the less hardship involved. Possibly also the fact that they intended "the next winter to fish for whale here" may indicate that they were aware that the Right Whale left the coast in the warm season.

1635.— John Winthrop in his History of New England from 1630 to 1649 (1825, vol. 1, p. 157) mentions that in April of this year three or four whales were cast ashore on Cape Cod, a thing which, he says, happens "almost every year." That these were large whales, and probably Right Whales, is indicated by the fact that several of the Massachusetts Bay colonists sailed across the Bay to try out the oil.

1668.— An old journal, kept by the Rev. Simon Bradstreet, mentions the capture of a whale, doubtless of this species, in Boston Harbor, "below the Castle" in the month of October (New Eng. Hist. and Geneal. Record, 1855, vol. 9, p. 44).

1697.— The good Cotton Mather in this year makes mention of a cow whale with its calf, captured at Yarmouth, Mass. "The cow was 55 feet long: the bone was 9 or 10 in. wide; a cart upon wheels might have gone into the mouth of it. The calf was 20 ft. long, for unto such vast calves the sea-monsters draw forth their breasts. But so does the good God here give this people to suck the abundance of the seas."

1703.— About the middle of February, three "great whales, betwixt six and seven and eight foot bone" were killed or wounded in the waters about Martha's Vineyard, and the wounds and the marks of the harpoons are recorded by the Clerk of Edgartown (Starbuck, 1878, p. 35).

1706.— Under date of December 10th, John Higginson of Salem writes to Symond Epes of Ipswich concerning "a rumor of several whales, that are gotten" (J. B. Felt: History of Ipswich, Essex, and Hamilton, 1834, p. 109). Probably this refers to Right Whales killed in Ipswich Bay.

1707.— Starbuck (1878, p. 34) mentions that the Boston papers of December 12th, recount the pursuit and capture of a whale 40 feet long in Boston Harbor, near the back of Noddle's Island. Probably, from the size, and the fact that it was pursued and killed, it was a Right Whale.

[1] A Relation or Journal of a Plantation settled at Plymouth in New England, and Proceedings thereof: etc. Coll. Mass. Hist. Soc., 1802, ser. 1, vol. 8, p. 204.

1712.— An item in the Boston News-Letter for Dec. 8, 1712, tells us that on the 25th of November, "six men going off the Gurnet Beach in a whale boat at Duxberry after a whale, by reason of the Boisterousness of the sea, oversetting the Boat, they were all drowned" (Justin Winsor: History of Duxbury, Mass., 1849, p. 86.)

1724.— Winsor (History of Duxbury, Mass., 1849, p. 86) notes on December 3d, "a whale captured off the beach."

1736.— In March, a large whale was captured at sea by a vessel from Provincetown, and its blubber brought into that port for trying out. That this was a Right Whale is evidenced by the amount of oil, estimated at over 100 barrels (Boston News-Letter, Apl. 1, 1736).

Starbuck (1878, p. 158) quotes the Boston News-Letter of Mar. 18th, that a whale was "lately killed near Cape Cod" that would make its owners £1,500. He adds that this must have been either an extraordinary whale or a surprising inaccuracy, implying a yield of at least 2,500 pounds of whalebone and about 290 barrels of oil at prices then current. This supposed yield is very nearly that of the Arctic Bowhead Whale, and it is to be regretted that more data are not available for determining if a straggler of that species may not have occasionally followed the polar current thus far to the south (see also a record under the year 1843).

1755.— On February 10th, of this year, a town meeting, at Truro, to hear and act upon the reply of a Rev. Caleb Upham, in response to a call to this parish, was by vote adjourned to the following day, "inasmuch as many of the inhabitants are called away from the meeting by news of a whale in the bay." This incident shows the importance of the occasional captures of whales at that time, and that the people were in readiness to pursue them whenever they appeared.

1800.— On April 10th, a number of whales appeared on the north side of Nantucket two or three miles off the land. Several boats were at once sent in pursuit, and succeeded in killing two and towing them ashore. The larger made thirty-one, the smaller (evidently a calf) but sixteen barrels of oil. April 19th, nine days later, a 30-barrel whale was killed and brought into the harbor (O. Macy: History of Nantucket, 1835, p. 150). These whales were doubtless Right Whales, not only because of the amount of oil they yielded but because they could be floated ashore.

1822.— Under date of March 28th, the Nantucket Inquirer notes that four smacks were engaged in whaling off Long Island in the early part of that month, and had brought to land at Spermaceti Cove a 50-barrel whale. A second was reported to have been captured at the same time. In the Inquirer of April 4th, it is stated that "another large whale has been taken near Sandy Hook." Again, under date of May 9th, "A whale was struck, in Boston Bay, a few days since, by a Cape Cod vessel, but broke the tow line and escaped." These records with little doubt, apply to the Right Whale. The first, because of the large yield of oil, could be

referred to none other; and the last, because of the fact that the Cape Cod people recognized the futility of pursuing Finbacks, and were not in the habit of molesting them.

1826.— About the middle of May, according to an item in the Sagharbor Corrector (copied in the Inquirer of May 20th) a small party of Right Whales appeared off Wainscott, eastern Long Island. Two were first seen, one of which, estimated to be a 100-barrel whale, was struck but escaped. Shortly, a calf was discovered and killed, which, it was estimated, would produce forty barrels of oil. At the same time a 100-barrel whale was killed at Westhampton. Here, then, were four Right Whales, three large and one small, off the shores of eastern Long Island.

1828.— In February (according to the Inquirer of the 22d of that month), a Right Whale 44 feet long, and rated at about seventy barrels of oil, was killed in the waters off Providence, R. I., after having been seen for several days "sporting in our river."

1838.— A Right Whale, about 40 feet long, was found dead off Newburyport, Mass., about September 1st, and towed ashore at Salisbury Point. It was estimated that it would make about forty barrels of oil (Newburyport Herald). This is unusually early in the fall for this species to appear on our coasts.

1840.— A 40-barrel Right Whale was killed off Amagansett, eastern Long Island, about May 1st (Inquirer, May 8, 1840).

At about this time also, Linsley (1842, p. 352) writes that a whale of this species was taken at Stonington, Connecticut "a few years since." It was a small one, yielding twenty-seven barrels of oil, but another from the same 'gang' was taken into Montauk, Long Island, that yielded sixty barrels.

1843.— On May 11th of this year, what is said to have been the largest Right Whale ever taken on this coast was killed in the South Channel, southeast of Chatham, Mass., by a crew of Provincetown men, in the little pink-stern schooner *Cordelia*. According to a note in H. A. Jennings's Provincetown or, Odds and Ends from the Tip End (1890, p. 193) this whale was estimated at nearly three hundred barrels of oil and about one and one half tons of whalebone. "The little craft not having the facilities for handling the monster, saved only about one hundred and twenty-five barrels of the oil and three hundred pounds of the bone, which was over fourteen feet in length [!]. The little craft was then full, hold and deck. Signals were made to a passing vessel but no notice was taken, so the rest of the whale was abandoned. The value of the fish was over $12,000." A contemporary item in the Boston Advertiser, copied in the Nantucket Inquirer of July 1, 1843, briefly recounts this capture, and gives the locality as thirty-five miles offshore, Nantucket bearing W. by N. It adds that "the whale is the largest that has ever been caught from Provincetown, and is supposed to be the largest ever seen upon our coast." If the statement be really correct that the whalebone was fourteen feet long, it may be that the whale was a stray specimen of the Arctic Bowhead (*Balaena mysticetus*), a supposition that is somewhat strengthened by the fact of its immense yield of oil.

1847.— The Inquirer of April 21st, notes that five whales were taken off the east coast of Long Island, on one day of the previous week, between Southampton and East Hampton.

1848.— About the last week of January several whales were seen off Long Island and one was killed near Southampton (Inquirer, Jan. 28, 1848).

About the middle of April, a considerable number of Right Whales were seen off the Massachusetts coast, near Plymouth, and five vessels went off in pursuit, but with what success does not appear. At the same time a few were seen off the eastern coast of Long Island, of which two were killed, one near Binghampton, the other near Southampton (Inquirer, Apl. 17, 1848).

1850.— A large Right Whale was captured during the last week of January, in Provincetown Harbor (Inquirer, Jan. 28, 1850); a second, yielding about fifty barrels of oil, was taken a week later (about the first of February) in the same harbor (Inquirer, Feb. 4, 1850).

About November 1st, a Right Whale appeared, again in Provincetown Harbor, and after a hard fight in which one boat was damaged and the helmsman injured, was finally killed. It yielded about sixty barrels of oil (Inquirer, Nov. 6, 1850).

1851.— A whale about 44 feet long was captured March 1st, near the shore at Southampton, Long Island. It was estimated to yield only about thirty barrels (Inquirer, Mar. 10, 1851). A second Right Whale was taken at the same place about two weeks later (Inquirer, Mar. 21, 1851). From the fact that it yielded but twenty-five barrels of oil, it was probably a calf.

1852.— About the middle of May, a large Right Whale was captured in Massachusetts Bay by a crew from Provincetown. It yielded seventy-five barrels of oil, the whalebone was eight feet long, and the total value of oil and bone was about $2000 (Inquirer, May 17, 1852).

During the month of May, five Right Whales were killed off Southampton, Long Island, three in the first nine days of the month, and two on a single day near its close. One of these yielded forty barrels, the two last together, seventy barrels (Inquirer, May 17, and June 4, 1852).

According to the Inquirer of October 13, 1852, two "whales" were captured by a Provincetown whaling schooner in Massachusetts Bay in the early part of October. Though there is no conclusive evidence as to the species, they were probably Right Whales.

1853.— This season seems to have been very favorable for whales on the east coast of Long Island. During March, the schooner *Corwin* of Greenport, L. I., made her first trip of about two weeks whaling, and although whales were seen every day, the sea was so rough that but one was killed. This yielded forty-one barrels of oil. On her second cruise, the *Corwin* captured a whale April 1st, that made seventy or eighty barrels of oil. On March 19th, a Right Whale was struck by a boat's crew from Amagansett, but was not taken (Inquirer, April 13, 1853). About the middle of April, a large whale rated at forty-five barrels, was killed off Southampton, Long Island (Inquirer, April 18, 1853).

The Inquirer of May 18, 1853, relates that several whales had been seen and chased among the vessels at anchor in Provincetown Harbor during the spring and that three or four vessels

there were fitted for a few days' whaling cruise about the shore. Two whales were killed in the harbor and a third escaped during the latter part of April. The record does not indicate what species of whale is meant, but some at least may have been Right Whales.

1854.—A 30-barrel Right Whale was struck off Southampton, Long Island, on April 29th, (Inquirer, May 10, 1854). This whale proved to be a fighter, and turning on his pursuers, demolished their boat and though mortally wounded, injured several of the whalers.

About the middle of December, a dead Right Whale, 48 feet long, drifted ashore at the mouth of Sandwich Harbor, Mass. The blubber was said to be seven inches thick, and the oil would amount to thirty or forty barrels. A harpoon found in the whale was supposed to have been the cause of its death. This whale was probably the one struck in Provincetown Harbor on December 11th, and subsequently lost through the parting of the line (Inquirer, Dec. 20 and 25, 1854).

1855.— A "'longshore whale" was captured off Southampton, Long Island, on April 16th, by one of the whaling companies. It was brought to shore for trying out the oil, of which about thirty barrels were expected (Inquirer, April 25, 1855). From the amount of oil, and the fact that the carcass was floated ashore, this was doubtless a Right Whale.

1858.— A 40-barrel whale was killed off the coast of Southampton, Long Island, about the first of March (Inquirer, Mar. 5, 1858). A second Right Whale, which yielded about thirty barrels of oil, was killed off East Hampton, Long Island, in the latter part of November, by boats from the shore. In the last week of the same month, a large Right Whale appeared in Provincetown Harbor, and though several times fired at with harpoon guns, eventually escaped (Inquirer, Nov. 30, 1858).

1863.— A large Right Whale appeared off the south coast of Nantucket, a short distance from shore, about the 10th of November, but was not molested (Inquirer, Nov. 14, 1863).

1864.— A Right Whale was killed in Cape Cod Bay, in April of this year. It was said to have been 48 feet long, and to have yielded eighty barrels and fourteen gallons of oil (which sold at $1.14 per gallon) as well as a thousand pounds of whalebone valued at $1,000. The skeleton of this whale is now mounted in the Museum of Comparative Zoölogy, at Cambridge. Mr. J. Henry Blake has kindly informed me that according to one of the captors of this whale it was actually killed within about four miles of Gurnet Lights, Plymouth, and towed by the *Wasp* to Provincetown.

In the last week of November, two Right Whales were seen lazily moving about at the north end of Nantucket, inside the bar. A boat was manned and went in pursuit, but was unable to get fast (Inquirer, Nov. 30, 1864).

1870.— A Right Whale with a calf, entered Provincetown Harbor about the first of March, and was at once pursued by a boat from the shore. In lancing the whale, the line was cut and the animal escaped (Inquirer and Mirror, Mar. 6, 1870).

1876.— About the first week in November a 40-barrel Right Whale grounded on the

bar near Capaum Pond, Nantucket. By the time a boat had been manned and sent in pursuit from the shore, the whale had freed itself and headed back to deeper water. Although closely pursued it finally escaped (Inquirer and Mirror, Nov. 11, 1876).

1877.— A "large scrag whale" was seen in the outer bay of Nantucket about the first of November (Inquirer and Mirror, Nov. 3, 1877).

1884.— About the last of March, Right Whales were seen off Long Island. Crews put off in pursuit of a large whale and her calf, but after being led twenty miles out to sea, were forced to relinquish the chase (Nantucket Journal, Apl. 3, 1884).

1886.— About the middle of April a small school of Right Whales appeared off Tuckernuck Island, Mass., and seems to have remained in the neighborhood a week or more. At all events Right Whales were sighted on several subsequent days. The report states that a small school of whales was first seen off Smith's Point, and on their reappearance two days later, a boat was sent in pursuit. A 60-barrel Right Whale was soon struck and it at once headed to sea, towing the boat at a lively pace. When about thirty miles from land, the men deemed it best to cut the line, as a thick fog had come on, and with difficulty they found their way back to Muskeget. Four days later, whales were again sighted off shore, and very soon a 40-barrel whale was struck and killed. This whale almost at once sank in eleven fathoms of water, so that the crew was obliged to fasten a buoy to it until it rose the following day by reason of the gases generated through decomposition (Nantucket Journal, Apl. 22, 1886). A later report states that all told three Right Whales were killed and brought to Tuckernuck, and that the first whale struck and lost, was later picked up and towed into New Bedford. The yield from the three whales was about 125 barrels of oil and 1500 pounds of whalebone (Nantucket Journal, Apl. 29, May 6, 1886). Near the last of April, a school of about twenty-five whales appeared in the same vicinity, and the schooner *Glide* put to sea in pursuit, but returned without having made a capture. Shortly after the vessel's departure from Miacomet Rip, three large whales appeared and for several hours were seen near where the *Glide* had been anchored (Inquirer and Mirror, May 8, 1886). Again, about the 10th of May, a Right Whale was seen off Siasconset, Nantucket Island. It followed the shore line for a long distance within one or two hundred yards of the beach, occasionally rising to blow. So clear was the water that the whale was plainly visible from the bluff as it swam at no great depth beneath the surface (Nantucket Journal, May 13, 1886). This is the largest visitation of Right Whales to our coast of which we have any record in recent times.

The Nantucket Journals of April, 1887, have several other references to whales seen off the coast of the island, but there is no clue to the species.

1887.— Mr. J. Henry Blake notes that a bull Right Whale, taken this year at Provincetown, made seventy barrels of oil, and measured 47 feet in length.

1888.— Two Right Whales were killed in Massachusetts Bay, off Provincetown, about

the 20th of May. Together they yielded about 170 barrels of oil. A few days later a Right Whale about 50 feet long was found dead near the George's Bank and brought to Provincetown. It seems to have been one killed the previous week by the steamer *A. B. Nickerson* (Nantucket Journal, May 24, May 31, 1888).

In the first week of June, the steamer *A. B. Nickerson,* while hunting for whales off Cape Cod, discovered a Right Whale with a calf and succeeding in killing them both with bomb-lances. The calf soon sank but the old whale was secured and towed to Provincetown. It was a very large one 55 or 60 feet long and estimated at one hundred barrels of oil and 1500 pounds of whalebone (Nantucket Journal, June 7, 1888). This is an unusually late date for the Right Whale on our coasts.

1891.— Several Right Whales were seen off Surfside, Nantucket, about the first week in April (Inquirer and Mirror, Apl. 11, 1891).

1893.— Major E. A. Mearns furnishes me with a note of what was said to have been a Right Whale, about 50 feet in length, that was stranded on Ochre Point, Newport, R. I. The blubber had already been removed by one Mr. Church at Tiverton, where the whale had been killed. The carcass was finally sunk at sea by order of the City Council. The exact date is not available.

1894.— Major Mearns sends me also the record of a Right Whale that appeared off Beaver Tail, Conanicut Island, R. I., in this year. It finally was sighted off Fort Adams, where it was shot and killed (exact date unknown). He adds that Mr. Joshua P. Clark, formerly in charge of the Life Saving Station at Watch Hill, R. I., told him that Right Whales have been seen off Block Island in more recent years, although the most part of the whales seen in those waters are Finbacks.

1895.— A large bull Right Whale measuring some 42 feet in length, and rated at fifty or sixty barrels of oil, was killed in late March, off Nahant. According to the reports, this whale, or what was believed to be the same individual, first appeared early in the preceding October near Hull, Mass., and was usually to be seen in the deep water near Harding's Ledge, or elsewhere in that part of Boston Bay. A crew of experienced men was finally got together, and succeeded in harpooning the whale, which eventually made off with some thirty fathoms of line attached to a stout cask. Two days after (on April 1st) the whale was found dead 25 miles north of Race Point by the tug *Peter Bradley* from Provincetown, whither the prize was at once taken. It was later exhibited at Boston (Nantucket Journal, Feb. 7, Mar. 14, May 9, 1895). The fact of its having wintered in Boston Bay from October till March, is certainly of much interest if true. The actual substantiation of this belief is, of course, quite out of the question. My friend, Mr. J. Henry Blake, has given me some measurements of this whale, which are elsewhere referred to, and from these he has drawn the subject of Plate 8.

1897.— Two Right Whales were seen off the Great Neck Life Saving Station, Nantucket,

about the 1st of April. Two boats were made ready and three days later several Right Whales appeared near the same place. The boats at once started in pursuit and one of them came nearly within striking distance when its rudder broke, so that the whale escaped (Nantucket Journal, Apl. 8, 1897).

1909.— On January 15th, a small Right Whale, nearly 35 feet long, came into Provincetown Harbor and entangled itself in one of the fish-traps, where it was killed by a bomb-lance. Local report states that the whale had been seen in the bay for a day or two previous. This specimen I saw five days later at Provincetown, and it was afterward brought to Boston and exhibited by some enterprising young undertakers who injected it thoroughly with formalin. One of the men at Provincetown, who had been once himself a whaler, vouchsafed the information that this was a "runt" or "*scrag*" whale, a term that formerly much mystified the systematists, who concluded from the accounts of whalers, that the "scrag" must be a distinct species, for which, indeed, Cope even erected a new genus (Agaphelus). I have elsewhere given notes and measurements of this specimen, and the sketch shown on Plate 9 is drawn from these.

1910.— Mr. D. C. Stull, of Provincetown, tells me that a Right Whale was seen in the waters off that port in the spring of this year, but it was not captured. He further says that they are more often seen in the spring, but of late years few have been observed. An old captain at Nantucket likewise informs me they are now of much rarer occurrence off those shores than formerly, and that the spring is the season when they are most apt to appear.

1913.— The Keeper at the U. S. Life Saving Station on Muskeget Island told me that "about three weeks ago" or about the 24th of May, two were seen together off the south shore of that islet but no one was prepared to give them chase.

From the table opposite, the numerous Long Island records have been omitted so that it refers wholly to the coast of Massachusetts and Rhode Island. It is curious that I have come upon no specific records for the Right Whale from the rocky shores of Maine, although Hitchcock includes it without comment in his nominal list of the Mammalia of that State.[1] Bigelow has shown (1914), however, that the northwestern part of the Gulf of Maine is relatively poor in plankton, which may in part account for this.

A survey of the foregoing records and table shows that the Right Whale is practically absent from the New England waters during the summer and fall from early June until October. The single September record is of a Right Whale found dead off Newburyport, Mass., about the first of that month, 1838. When this species was more plentiful than now, the first individuals doubtless appeared in our waters during the latter half of October, for at Long Island, according to the letter of Lord Cornbury in 1708 (see *antea*, p. 132) the whalemen there

[1] Hitchcock, C. H. Proc. Portland Soc. Nat. Hist., 1862, vol. 1, p. 66.

Records of Right Whales in New England.

(n = number indefinite).

Locality	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Cape Cod Bay	1620												n
Cape Cod	1635				3								
Boston Harbor	1668										1		
Cape Cod Bay	1700	n											
Martha's Vineyard	1703		3										
Ipswich Bay	1706												n
Boston Harbor	1707												1
Duxbury	1712											1	
Duxbury	1724												1
Off Provincetown	1736			2									
Truro	1755		1										
Nantucket	1800				$3+n$								
Boston Bay	1822					1							
Off Providence, R. I.	1828		1										
Off Newburyport	1838									1			
Off Chatham	1843					1							
Off Plymouth	1848				n								
Provincetown Harbor	1850	1	1									1	
Massachusetts Bay	1852					1					2		
Provincetown Harbor	1853				2								
Sandwich Harbor	1854												1
Provincetown Harbor	1858											1	
Nantucket	1863											1	
Nantucket	1864											2	
Near Provincetown	1864				1								
Provincetown Harbor	1870			2									
Nantucket	1876											1	
Nantucket	1877											1	
Off Tuckernuck Id.	1886				$2\,n$								
Off Siasconset	1886					1							
Massachusetts Bay	1888					2							
George's Bank	1888					1							
Off Provincetown	1888						2						
Nantucket	1891				n								
Nahant	1895			1									
Nantucket	1897				2								
Provincetown Harbor	1909	1											
Off Muskeget	1913					2							
Totals		$2+n$	6	5	$11+5n$	9	2	0	0	1	3	8	$3+2n$

began to "look out for fish" about the middle of that month. In October, 1688, a whale probably Eubalaena, was killed in Boston Harbor, and two others, probably also Eubalaena, in October, 1852, but otherwise, the earliest specific instances for its appearance in our waters in fall seem to be those given above for 1850, 1876, and 1877, when single individuals were noted during the first few days of November. The figures show that in this month and in December they were present in some numbers. Probably most of them were leisurely following the coast to more southerly latitudes, so that by January there is an apparent falling off, which in our table, owing to the paucity of entries, is perhaps more than normally evident. It is significant, however, that the addition of the Long Island records above detailed hardly changes the total for this month. The decrease after December no doubt indicates an actual migratory movement to the south, and is in accord with the statement of Dudley [1] in 1725, that in the fall of the year the Right Whales go westward, following the general trend of the shore. It seems that already by December this species used to appear off the coasts of Delaware, and probably wintered regularly as far south as the Bermuda Islands and the coasts of South Carolina. In the latter region they probably reached their general southern limit, and in this were doubtless influenced by the warm Gulf Stream waters which turn eastward away from the shore at about this latitude. Manigault (Proc. Elliott Soc., 1886, vol. 2, p. 98–104) describes a Right Whale killed in January, 1880, in Charleston Harbor, S. C., and a second shortly after was cast ashore on Sullivan's Island, S. C. A third was captured off the harbor of Port Royal, S. C., in February, 1884, and a fourth off Cape Lookout, North Carolina, Mar. 20, 1894. These are all therefore wintering animals. Some numbers must have wintered as far north as Massachusetts Bay, but probably the greater part move to the south of Cape Cod after December.

An instance of the supposed wintering of a Right Whale in Boston Bay is noted in 1895. What was believed to be the same individual was said to have appeared near Hull in early October, 1894, and after having been repeatedly seen in that vicinity during the succeeding months was finally killed near Nahant in the following March. The evidence does not seem wholly satisfactory that the October animal was even a Right Whale, but yet the story may be essentially true.

After January comes a distinct increase in the number reported in the Massachusetts and neighboring waters. This increase apparently took place from about the middle of February on, and it may be supposed that the northward migration of these whales had then already begun. In March and April the numbers increase, so that in the latter month they seem more numerous than at any other period of the year, along the southern coasts of both Massachusetts and Long Island. The reason for this is apparent; for in following the trend of our coast southward in fall, they must in part pass well out to sea beyond Cape Cod, but in returning north-

[1] Phil. Trans. Roy. Soc. London, Abridged, 1734, vol. 7, pt. 3, p. 426.

ward along the coasts of the central Atlantic States they are turned abruptly eastward by the outjutting mass of Long Island and the promontory ending in the elbow of Cape Cod. This barrier forms slightly more than a right angle with the general coastline to the south, and extends northeasterly for nearly five degrees of longitude or 250 miles. In passing northward therefore, a great part of the whales in a belt 250 miles in width, are turned to the eastward and converge on the south and east shores of Long Island and Massachusetts to round Cape Cod. That this period of greatest abundance was the same in former times as well as during the last hundred or more years, is evidenced also by the statement of Dudley, in 1725, previously quoted, that "in the Spring they are headed Eastward," and that "the true [*i. e.* best] Season for the right or Whalebone Whale, is from the Beginning of *February*, to the End of *May*." If a more or less steady continuance in this same direction were maintained it would result in comparatively few Right Whales reaching the northern part of the Gulf of Maine, just as in fall, the Nova Scotia peninsula would perhaps guide them off from those waters. This may in some measure account for their apparent absence or scarcity on the shores of northern New England. The more frequent appearance of whales in 'schools,' in the spring of the year may mean nothing more than this convergence of the lines of movement on our southern shores. Thus on April 10, 1800, a number of whales appear off Nantucket; again in the middle of May, 1826, a small school is found off eastern Long Island; five whales are killed off the same coast in one day in April of 1847; a considerable number are off Plymouth in mid-April, 1848; finally in mid-April of 1886, a small school of Right Whales appears off Tuckernuck and Nantucket, and near the end of the month the same or a second school, consisting of some twenty-five whales, the largest number together of which there is any record in our bounds for probably over a century. During the greater part of May the northeastward movement is continued, but is normally over by the middle of the month, for the records are very few indeed after the third week. The only June record that I have found of the Right Whale in our waters, is of a large cow with her calf, both of which were killed off Cape Cod early in the first week of June, 1888.

It is without the scope of the present paper to trace the northward course of the Right Whales after they have left our coasts in May. Suffice it to say that they seek the waters off the Grand Banks and thence northeasterly, even to Iceland. They appear to avoid the Newfoundland waters, and are not taken at the whaling stations there. They were formerly common in Iceland waters and according to Buchet (1895) and Collett (1909) they have again appeared in small numbers of recent years, usually in June and July. It should be noted, however, that those animals in the seas east of Iceland are quite likely the same that winter on the coasts of southern Europe. They were formerly common in the vicinity of the North Cape of Norway, whence the name 'Nordkaper,' applied by the whalers of those seas.

The reason of this seasonal migration of the Right Whale is not yet known. It is unlikely

that temperature is the direct cause, as some have supposed, and that the whales retire from the colder water of the north in order to seek warmer seas to the south. The thick coating of blubber must tend to protect the whale from extremes of temperature. More likely the question of temperature is indirectly of importance as it affects the animal life on which the whale feeds, so that more exact data as to the food of this species would probably be helpful in determining the cause for its migrations. The supposed retirement of the pregnant females to the quiet bays of more southern latitudes in order there to bring forth their young, seems also an insufficient reason, since both sexes migrate equally, and the quiet bays are hardly frequented by these animals. As already mentioned the small shrimp, *Thysanoëssa inermis*, on which this whale is known to feed, has been found in January on at least two occasions, in the Wood's Hole region, whereas Bigelow (1914) failed to find it at all during extensive towing operations carried on in July and August in various parts of the Gulf of Maine. It is common in more northern waters in summer, however. These facts may indicate that the Right Whale's migrations are undertaken in the pursuit of this crustacean, which is found in our waters in the colder months, but is apparently absent from them in summer.

Fossil Remains.— Although bones of whalebone whales are of "not infrequent occurrence on the less elevated terraces of the Pleistocene period on the Lower St. Lawrence," [1] and may represent perhaps three genera, there are but few records of the discovery of such remains within the limits of New England. Several vertebrae, considered "to be those of a Cetacean" were " dug up in a clay stratum, near the bed of a small stream in Machias, Me.,. . . .at the depth of about eight feet" nearly seventy years ago.[2] These were presented to the Society in its early days, and, in 1847, were submitted to Count Pourtalès for report, but there is no record of them further, nor is any indication given as to their identity. Since other fossils from these clays are of a comparatively recent type, it is probable that if they were really cetacean, they were of some living species.

Through the kindness of the authorities of the Peabody Museum at Salem, Mass., I have lately examined a large rib of Eubalaena in an excellent state of preservation, which was dug up at Newburyport, Mass., a few years since. The label indicates that it was found five feet under ground, but there is no record of the exact spot nor of the nature of the soil. It shows no appearance of great age and is very likely modern. The two portions (for the lower end is broken off) together measure 75 inches along the outer curve.

In a previous century, Zaccheus Macy of Nantucket, writing to the Massachusetts Historical Society [3] under date of October 10th, 1792, says that "one time when the old men were digging a well at the stage called Siasconset, it is said, they found a whale's bone near thirty feet below the face of the earth, which things are past our accounting for." [3]

[1] Dawson, J. W. Canadian Nat., 1883, new ser., vol. 10, p. 385.
[2] (Jackson, C. T.) Proc. Boston Soc. Nat. Hist., 1847, vol. 2, p. 255.
[3] Macy, O. History of Nantucket, 1835, p. 263.

The occurrence of remains of modern species of large Cetacea in our Pleistocene clays, especially those of Vermont and southern Maine, is to be looked for, in association with those of the White Whale, the Walrus, and sundry mollusks already known from those formations.

New England Right Whale Fishery.

The Right Whale fishery on the New England coast, at one time a regular and lucrative pursuit, has long since ceased to exist except in the most casual way. From the time of the settlement of Plymouth for a hundred years, it employed many small boats and a large proportion of the settlers at certain times of the year when the whales were to be found along the shores. The accounts of this important industry that have come down to us are barely sufficient to reconstruct an outline of it. As the whales became less frequent in the nearer waters, larger craft were fitted out for taking them at sea. At first these vessels made cruises of only a few days at most, but gradually they fared farther and farther from the home ports in pursuit of both Right and Sperm Whales, and even to the arctic ice for the Bowhead. Thus began to develop the whaling industry of Nantucket and New Bedford, the importance of which it is difficult to estimate, not alone on account of the fortunes made by the ship owners, but because of the training in seamanship that helped to establish the future nation's naval prestige. The rise and development of American whaling has been often traced, and need not here concern us.

The American Indians probably attacked the whale but seldom. An occasional dead one cast on shore, was nevertheless much appreciated by their hardy stomachs. Thus good Roger Williams of Rhode Island, in his Key into the Language of America, printed in 1643, defines the word "Potop; *the whale*," and adds: "In some places whales are often cast up. I have seen some of them, but not above sixtie foot long. The natives cut them in several parcels, and give and send them far and near, for an acceptable present or dish" (Coll. Mass. Hist. Soc., 1810, ser. 1, vol. 3, p. 224). Bartholomew Gosnold in the last of May, 1602, found at the north end of Cuttyhunk Island, Mass., "many huge bones and ribbes of whales," the remains, perhaps, of such as had drifted ashore or been killed by the aborigines. The Indian shell heaps on the Maine coast have also yielded a few portions of whale bones, to indicate that the natives occasionally feasted on whale meat.

In Rosier's Relation of Waymouth's Voyage to the Coast of Maine, 1605 (republished by the Gorges Society, 1887, p. 158) is a quaintly worded account of aboriginal whaling by the New England Indians: "One especiall thing is their manner of killing the Whale, which they call Powdawe [in the Abenaki tongue, the editor explains, this signifies 'he blows' — the Abenaki for whale is 'Pudébé'] and will describe his forme; how he bloweth vp the water and that he is 12 fathoms long; and that they [the Indians] go in company of their King with a multitude of their boats, and strike him with a bone made in fashion of a harping iron fastened

to a rope, which they make great and strong of the barke of trees, which they veare out after him; then all their boats come about him, and as he riseth aboue water, with their arrowes they shoot him to death; when they haue killed him & dragged him to shore, they call all their chiefe lords together, & sing a song of joy: and those chiefe lords, whom they call Sagamos, divide the spoile, and giue to euery man a share, which pieces so distributed they hang vp about their houses for prouision: and when they boile them, they blow off the fat, and put to their peaze, maiz, and other pulse, which they eat." The species of whale thus killed by the Indians is not indicated, but it is unlikely that they could attempt the capture of any but Right Whales, which were the least difficult to overcome. Doubtless a log of wood was fastened as a drag to the rope which the Indians "veared out" on striking the whale.

An absurd relation by Joseph de Acosta, in 1590, of a supposed method of capturing whales by the Indians of Florida, gained currency, and long was quoted in the old works on natural history, to the effect that the Indian approached the sleeping whale in his canoe and drove a wooden stake into each of its nostrils, after which he continued to bestride his quarry till its struggles ceased, and then towed it ashore. A cleverly executed engraving illustrative of this strange story was published in the same year by Theodore de Brie in his Collectiones Peregrinationum in Indiam Orientalem et Occidentalem (Frankfurt am Main, 1590). The figures appear to represent Right Whales.

Early Whaling at Cape Cod and Massachusetts Bay.— When the historic *Mayflower* rounded Cape Cod into Massachusetts Bay, she carried on board a "master and his mate, and others, experienced in fishing" who greatly regretted their lack of proper tackle for the taking of the whales that daily came about their ship. Bradford's Journal informs us that these people intended the following year to "fish for whale here," but with what success we are not informed, if indeed the project was carried out at that time. That the whales were then (December, 1620) common and that their value was appreciated by our forefathers, is further shown in Bradford's remark that "we saw daily great whales [at Cape Cod], of the best kind for oil and bone, come close aboard our ship, and, in fair weather, swim and play about us." Evidently these were Right Whales, since the quality of their oil and 'bone' was well known to the seamen. The narrator adds: "There was once one, when the sun shone warm, came and lay above water, as if she had been dead, for a good while together, within half a musket shot of the ship; at which two were prepared to shoot, to see whether she would stir or no. He that gave fire first, his musket flew in pieces, both stock and barrel; yet, thanks be to God, neither he nor any man else was hurt with it, though many were there about. But when the whale saw her time, she gave a snuff, and away." [1] So ended the first attempt of the Pilgrims to capture whales in New England.

In 1629, Higgeson, "a Reverend Divine," mentions in his account of the "commodities"

[1] Young, Alexander. Chronicles of the Pilgrim Fathers, 1844, p. 146.

of New England "great store of whales, and crampusse."[1] Higgeson lived at Salem. Richard Mather, who came to Massachusetts Bay in 1635, likewise tells of "mighty whales spewing up water in the air, like the smoke of a chimney, and making the sea about them white and hoary, as is said in Job, of such incredible bigness that I will never wonder that the body of Jonas could be in the belly of a whale" (Sabine's Report, p. 42).[2] Starbuck shows that one of the motives for the establishment of the Massachusetts Bay Colony was the promise of a good return from the fisheries, and in the original charter the colonists were "given and graunted ....all fishes — royal fishes, whales, balan, sturgeons, and other fishes, of what kinde or nature soever that shall at any tyme hereafter be taken in or within the saide seas or waters." The Massachusetts colonists were quick to avail themselves of such whales as were drifted to their shores. Thus, John Winthrop of the Massachusetts Bay Colony writes that in April, 1635, "some of our people went to Cape Cod, and made some oil of a whale, which was cast on shore. There were three or four cast up, as it seems there is almost every year."[3] These were probably Right Whales, at this season moving northward, and the amount of oil yielded was thus sufficient to induce the people to sail across the Bay to render it.

Concerning the capture of whales on our coasts previous to 1650, no record appears to have come down to us. There is an old poem on New England written by William Morrell, who came to Plymouth in 1623. It was published in London, on his return to England, and implies that whales were already an object of pursuit on our shores, for

> "The mighty whale doth in these harbours lye,
> "Whose oyle the careful mearchant deare will buy."[4]

Certain it is, however, that Right Whales were common in their season, and that the colonists were beginning to make serious efforts for their capture. This is evident from the frequent orders of the General Court concerning the granting of fishing privileges, and the many references to 'drift' whales which after being harpooned, had escaped, only to die and drift ashore. Controversy waxed high over the title to possession of such 'drift fish,' for it has ever been the whaleman's law that he who first struck the whale has the prior claim. If, therefore, such title could not be shown, either by the identification of the harpoon (marked so as to be known) or by some other sign, then the finder of the dead animal was entitled to all or part of his find.

It is clear that for some time previous to 1650 the settlers of Cape Cod and Massachusetts Bay undertook to carry out the intention of the *Mayflower's* master, "to fish for whale

[1] New-Englands Plantation. Or a short and true Description of the Commodities and Discommodities of that countrey. Written in the year 1629, by Mr. Higgeson, a Reverend Divine, now there resident. Reprinted in Coll. Mass. Hist. Soc., 1806, ser. 1, vol. 1, p. 119.

[2] Starbuck, A. History of the American whale fishery. Rept. U. S. Comm. Fish and Fisheries for 1875–6, 1878, p. 5.

[3] Winthrop, John. History of New England from 1630 to 1649, 1825, vol. 1, p. 157.

[4] Reprinted in Coll. Mass. Hist. Soc., 1806, ser. 1, vol. 1, p. 130.

here." In the decade following 1650, the Court records show frequent suits for the adjudication of the claims of rival whalers; moreover, the fact that at this time the General Courts of the Plymouth and Massachusetts Bay Colonies began to formulate regulations for the prevention of strife and misunderstanding over the ownership of dead whales, is evidence that the industry was then beginning to flourish and that numerous whales were killed.

Even at this early date, it appears that the Government claimed a portion of the oil of whales cast on shore within the bounds of the Colony. So in 1652, "Mr. Howes" was appointed "to receive the oil of the country" for the town of Yarmouth, Mass.[1] At the same time it was ordered by the town of Sandwich, Mass., "that Edmund Freeman, Edward Perry, Geo. Allen, Daniel Wing, John Ellis, and Thos. Tobey, these six men, shall take care of all the fish [including whales and 'grampuses'] that Indians shall cut up within the limits of the town, so as to provide safety for it, and shall dispose of the fish for the town's use; also that if any man that is an inhabitant shall find a whale and report it to any of these six men, he shall have a double share; and that these six men shall take care to provide laborers and whatever is needful, so that whatever whales either Indian or white man gives notice of, they may dispose of the proceeds to the town's use, to be divided equally to every inhabitant." [2] Apparently it was not long before a misunderstanding arose as to the legal definition of the phrase "every inhabitant," for in the following year, 1653, the town ruled "that the pay of all whales shall belong to every householder and to every young man that is his own, equally." This method of sharing the proceeds of drift whales seems to have met with small favor, or perchance certain shrewd citizens thought to make a greater personal profit from such occasional finds, for in the same year, September 13, 1653, it was further ordered "that Richard Chadwell, Thos. Dexter, and John Ellis, these three men, shall have all the whales that come up within the limits and bounds of Sandwich, they paying to the town for the sd. fish £16 a whale." It was also "provided that if any of these three men have notice given them by any person who has seen a whale ashore or aground and has placed an oar by the whale, his oath may, if required, be taken for the truth and certainty of the thing, and the sd. three persons shall be held liable to pay for the sd. whale although they neglect to go with him that brings the word. And if they do not go with him, then sd. person shall hold the sd. whale, and by giving notice to any third shall have paid him for his care herein £1. [The whale then evidently becomes town property.] And in case there come ashore any *part* of a whale, these four men, Mr. Dillingham, Mr. Edmund Freeman, Edward Perry, and Michael Blackwell, are to be the judges of the whale before it shall be cut off from, to determine the quantity less a *whole* whale; and then, without allowing further word, those three men, viz.: Rd. Chadwell, Thos. Dexter, and John Ellis, shall make payment for sd. whale, $\frac{1}{3}$ in oil, $\frac{1}{3}$ in corn, and $\frac{1}{3}$ in cattle, all market-

[1] Swift, C. F. History of Old Yarmouth, 1884, p. 84.
[2] Freeman, F. History of Cape Cod, 1862, vol. 2, p. 50.

able, at current prices." [1] It is clear that the chief purpose of these regulations was to insure that the town received a certain amount from the proceeds of each whale or part thereof for the public treasury. The aforementioned John Ellis seems to have had a great liking for this whale enterprise, for again in 1659, six years after, he is appointed together with one James Skiff "to take care of the whales and all other fish that yield oil in quantity," and later, the town sold to him "the right of all such fish coming within the limits and bounds of the town the next three years." At this time, too, there appears, among the list of subscriptions for building a new meeting house, the item: "Rec. also in Oil £3.3.10," no doubt part of the proceeds of some whale killed or stranded on the Sandwich shore.[2]

In the Massachusetts Bay Colony at this period, it was apparently the law that one third of the oil of drift whales became the property of the Crown, one third went to the town, and the remainder to the finders of the whale. This is evidenced from the Court records of May 14, 1654, wherein it appears that "an account concerning a whale taken at Weimouth being presented to this Courte, itt is referred to the auditor gennerall to pervse the accompt, and examine what is due to the countrje, all charges being deducted, and orders that what vppon examination shallbe found due, the countrje shall haue one third p̃te, the towne of Weimouth another third p̃te, and the finders the other third p̃te." [3]

In addition to these regulations for determining in general the rights of persons finding stranded whales on the shores, it soon became necessary to define the title to such whales as were cast up on the bounds of private homesteads. So, in the Court Records of June 6, 1654, it is ordered for the Plymouth Colony, "that whatsoeuer whales or blubber shalbee cast vp against the lands of the purchasers, that the proprietie thereof shalbelonge vnto the said purchasers accordingly as vnto any of the p̃ticulare townshipps when such whales or blubber fales within any of theire precincts." [4] That is, apparently, that the whale was considered the property of the land owner, who nevertheless, was to pay one third of the oil to the Crown.

It is to be inferred that the method of appointing certain persons to attend to the saving of the oil of these 'drift' whales was commonly resorted to by most of the towns of the Plymouth Colony at least. As in the case of the citizens of Sandwich, such persons paid to the town a certain amount for the local monopoly of this privilege. This arrangement, however, seems at times to have aroused the cupidity of the less fortunate colonists, for in the Judicial Acts of the Plymouth Colony [5] in 1662, we find that "Thomas Howes, Sen^{r}, and Robert Denis, complaineth in the behalfe of themselues and the rest of theire naighbours, whoe by towne order are to haue theire shares of the whales this yeare, w^{h} by Gods providence are or shalbee

[1] Freeman, F. History of Cape Cod, 1862, vol. 2, p. 51.
[2] Ibid., p. 62.
[3] Records of the Massachusetts Bay Colony, 1854, vol. 4, pt. 2, p. 191.
[4] Records of the Colony of New Plymouth in New England, 1855, vol. 3, p. 53.
[5] Ibid, 1857, vol. 7, p. 106.

cast vp within theire townshipes, against William Nicarson, Seni^r^, in an action of treaspas on the case, to the damage of forty pounds, for vnjust molestation in vnjust attachment of the blubber of a whale belonging to the said complainants. The jury find for the plaintiffes ten pounds damage, and the cost of the suite. Judgment graunted." The ground for William Nicarson's trespass does not appear, but it is likely that he believed the whale to be one that he had previously wounded, and so was loath to relinquish title to it when "by God's providence," it drifted ashore.

It is hardly to be doubted that most of these 'drift fish' had first been harpooned, so that the whalers naturally resented the claim of a third of the oil by the Crown, if they subsequently regained the lost carcass. This exorbitant tax was doubtless the cause for a protest before the General Court of March 4, 1661, in which the agents for the town of Yarmouth appeared in behalf of their own town, as well as of Barnstable, Sandwich, and Eastham, to "debate and determine a difference between them and others about whales." It appears that the matter was not settled at that time, although the Court endeavored to effect some sort of a compromise. The four towns stoutly refused to pay what they considered an unjust tax, so that six months later, on October 1, 1661, the Colonial Treasurer, to whom the Court seems finally to have entrusted the whole affair, sent the following circular letter to the citizens concerned:

"Loueing Frinds: Whereas the Generall Court was pleased to make some propositions to you respecting the drift fish or whales; and incase you should refuse their proffer, they impowered mee, though vnfitt, to farme out what should belonge vnto them on that account; and seeing the time is expired, and it fales into my hands to dispose of, I doe therefore, with the advise of the Court, in answare to youer remonstrance, say, that if you will duely and trewly pay to the countrey for euery whale that shall come, one hogshead of oyle att Boston, where I shall appoint, and that current and marchantable, without any charge or trouble to the countrey,— I say, for *peace and quietnes*, you shall haue it for this present season, leaueing you and the Election Court to settle it soe as it may bee to satisfaction on both sides; and incase you accept not of this tender, to send it [*i. e.* their refusal] within fourteen days after date hereof; and if I heare not from you, I shall take it for graunted that you will accept of it, and shall expect the accomplishment of the same.

"Youers to vse, Constant Southworth, Treasu." [1]

The record shows that this proposal was accepted and an agreement signed by the representatives of Yarmouth.

In this same year, 1661, a citizen of Eastham was fined by the magistrate one pound sterling for "lying about a whale"! [2]

The agreement just recited appears to have met with approval and was duly enacted as

[1] Records of the Colony of New Plymouth in New England, 1855, vol. 4, p. 6.
[2] Freeman, F. History of Cape Cod, 1862, vol. 2, p. 361.

a law. For in the following year, under date of June 3, 1662, the General Court of Plymouth Colony ordered that for every whale cast ashore, or cut up at sea and brought on shore, one full hogshead of oil was to be paid at Boston by the towns or persons "as are Interested in the lands where they fall or shall soe cutt vp any ffish at sea." If the "ffish" were torn or "wasted" so that one fourth of it were gone, then only one half a hogshead of oil was to be paid, and nothing if more than half the creature were lost. Probably it was to determine the proportion of oil due from some such damaged carcass, that, in 1672, "in reference vnto a whale brought on shore to Yarmouth from sea, the Court leaues it to the Treasurer to make abatement of what is due to the countrey therof, by law, as hee shall see cause, when hee treated with those that brought it on shore." [1]

Freeman[2] mentions an old Indian deed of January 15, 1679, confirmatory of the early purchase of Woods Hole, which stipulates that in consideration of the granting of certain lands, the Indian, Job Notantico, is to have "liberty to cut sticks and wood on the commons, the fins and tails of whales cast ashore on the neck" at Falmouth. This indicates not only the frequency with which whales were thus cast ashore, but perhaps also the industry of the people in thoroughly trying out the entire carcass, leaving only "fins and tails [=whalebone]" for Poor Lo. Later, at all events, it is certain that the carcass was usually abandoned after the blubber and whalebone were removed.

The people of Cape Cod at this time seem to have been carrying on their operations with much vigor. So frequently did dead whales come ashore that regulations were passed to provide at once for their safe disposal so that the country, the town, and other parties interested should in due course have their rightful share of the proceeds. So in February, 1680, the town of Yarmouth portioned out its shore into three sections and to each allotted four or five men to secure such whales as stranded within the several sections, fixing at the same time the remuneration for this public service. The record runs: "Agreed with our neighbours underwritten in their several bounds, to look out for and secure the town all such whales as by God's providence shall be cast up in their several bounds, for the sum of £4 a whale, to be paid in blubber or oil, till the town see cause to alter the manner: Paul Sears, Sam Worden, Silas Sears, John Burge, Annanias Wing, from Sawtucket to Sawsuit Harbor mouth. Joseph Howes, Sam Howes, John Hall, Jere. Howes, from Sawsuit to Yarmouth Harbor. John Rider, John Hallet, John Hawes, Capt. Thacher, from Yarmouth Harbor to the Mill Creek; and they are to have £5 for every whale that is cut up betwixt Gray's Beach and the Mill Creek, as aforesaid." [3] At Sandwich, in 1681, we find a committee appointed "to make sale of the whales that are lately cast ashore in the harbor; and it was agreed that Joseph Holway and those

[1] Crapo, W. W. Centennial in New Bedford, 1876, p. 66.
[2] Freeman, F. History of Cape Cod, 1862, vol. 2, p. 427.
[3] Swift, F. C. History of Old Yarmouth, Mass., 1884, p. 109.

with him in cutting-up the whales, shall have that part they have already cut and secured, on paying £6 silver money to the town." [1] This implies of course, that the regulation was still effective making drift whales the town property, with the exception, however, of the barrel of oil from each whale due the Colony. In the following year, December 8, 1682, it was ordered by the town, "that whales that come ashore, and other great fish that yield any quantity of oil, be given to Thomas Tupper, Geo. Allen, Caleb Allen, and Sam'l Briggs, for ten years, for one half the oil delivered at the dock in good casks — they to pay a barrel of oil out of every whale, to the country according to the order of court" (see *antea*, 1662).[2] No doubt much of the oil received by the Crown from such drift whales was sent to England for home consumption. At all events, Treasurer Samuel Sewall's accounts (in the Sewall papers of the Massachusetts Historical Society's Collections) show that in 1681 and thereabouts, he was regularly sending whale oil by packet boat to London. As elsewhere noted, the Nantucket whalers seem not to have made such shipments on their own account for nearly forty years after.

The Whale-viewer.— Strife as to the rights of ownership of whales seems to have continued unabated, so that in March of 1688, the colony of Massachusetts Bay established the following regulations, quaintly worded and misspelled: "furst: if aney pursons shall find a Dead whael on the streem And have the opportunity to toss herr on shoure; then ye owners to alow them twenty shillings; 2ly: if thay cast hur out & secure ye blubber & bone then ye owners to pay them for it 30s (that is if ye whael ware lickly to be loast;) 3ly, if it proves a floate son not killed by men then ye Admirall to Doe thaire in as he shall please; — 4ly; that no persons shall presume to cut up any whael till she be vewed by toe persons not consarned; that so ye Right owners may not be Rongged of such whael or whaels; 5ly, that no whael shall be needlessly or fouellishly lansed behind ye vitall to avoid stroy; 6ly, that each companys harping Iron & lance be Distinckly marked on ye heads & socketts with a poblick mark: to ye prevention of strife; 7ly, that if a whale or whalls be found & no Iron in them: then they that lay ye neerest claime to them by thaire strokes & ye natoral markes to haue them; 8ly, if 2 or 3 companyes lay equal claimes, then thay equelly to shear." [3] By these regulations, were established legal rates for salvage of 'drift' whales, a system of marking harpoons and lances for their future identification by the rightful owners of the dead whales, and the appointment of two persons to act in some measure as referees in all cases of dispute.

Two years later, the people of Cape Cod adopted a somewhat similar set of regulations, and at a General Court of the Plymouth Colony, November 4, 1690, we find it "ordered, that for the prevention of contests and suits by whale killers,—

"1. This Court doth order, that all whales killed or wounded by any man & left at sea,

[1] Freeman, F. History of Cape Cod, 1862, vol. 1, p. 73.
[2] Ibid., p. 75.
[3] Mass. Colonial MSS., Treasury, vol. 3, p. 80; quoted by Starbuck, Rept. U. S. Comm. Fish and Fisheries, 1878, p. 8.

s^{d} whale killers that killed or wounded s^{d} whale shall presently repaire to some prudent person whome the Court shall appoint, and there give in the wounds of s^{d} whale, the time & place when & where killed or wounded; and s^{d} person so appointed shall presently comitt it to record, and his record shall be allowed good testimony in law.

"2. That all whales brought or cast on shore shall be viewed by the person so appointed, or his deputy, before they are cut or any way defaced after come or brought on shore, and s^{d} viewer shall take a particular record of the wounds of s^{d} whale, & time & place when & where brought on shore; & his record shall be good testimony in law, and s^{d} viewer shall take care for securing s^{d} fish for the owner." This same court order further provides that any person finding a 'drift' whale "on the stream, a mile from the shore, not appearing to be killed by any man," may secure it to his own use, not omitting, however, to pay "an hogshead of oyle to y^{e} county for every such whale." [1]

Thus was established the office of Whale-viewer, whose duty it was to examine all whales that came ashore within his jurisdiction and to record not only the marks and wounds of these, but those as well of whales that were reported harpooned at sea and escaped, according as the pursuers gave their testimony. By this means it was hoped to identify lost whales, should they subsequently die of their wounds and be cast on shore. Such whales would then be made over to their rightful owners, if satisfactory proof could be shown through the record of marks and wounds, for otherwise they became the spoil of the finder or other person appointed for their disposal. That practically all the 'drift' whales were such as had been previously wounded is in itself eminently probable, and is further shown by contemporary evidence, for Weeden [2] tells us that "as early as 1681, Andros reported that very few whales were driven on shore, unless proved to have been struck by the fishermen."

Following its order of November 6, 1690, the General Court appointed "to view and inspect whales," Mr. Skiff of Sandwich, and Captain Lothrop of Barnstable.[3] In the same year, "John Wadsworth was appointed to view whales, that may be cast ashore in the town" of Duxbury.[4]

It is plain from these occasional fragments, that many whales were annually killed on the Massachusetts coast, and that a great number were struck and lost, only to die of their wounds and later drift to land.

The reason for so large a number of lost whales is not evident: whether through insufficient strength of warp and iron, or through lack of skill on the part of the many men employed, an alternative perhaps, hardly to be thought of. Perchance it may have been that the harpoon line was not always managed entirely from the whale boat, but was fastened to drags and thrown

[1] Records of the Colony of New Plymouth, 1856, vol. 6, p. 252.
[2] Weeden, W. B. Economic and Social History of New England, 1890, vol. 1, p. 435.
[3] Freeman, F. History of Cape Cod, 1862, vol. 1, p. 323.
[4] Winsor, J. History of Duxbury, Mass., 1849, p. 86.

overside while the boat was held in readiness for a chance to lance the whale when it again came to the surface. There is little, however, to support this view. Probably the whales themselves were so abundant that a great many were struck and it was often deemed better to cut loose from one that gave promise of a long chase, in order to attack others near at hand that perchance, would prove easier prey. In testimony of their abundance, Edward Randolph, in October, 1676, tells the Lords of Trade concerning the resources of the colony at New Plymouth, that "here is made a good quantity of whale oil, which fish they take upon the coasts." [1] Again, in 1688, he writes home from Massachusetts: "New Plimouth Colony have great profit by whale killing. I believe it will be one of our best returnes, now beaver and peltry fayle us" (Hutchinson's Coll., p. 588, quoted by Starbuck, 1878, p. 8). So, too, Cotton Mather, writing in 1697 of the colonists at Plymouth, says: "They have since passed on to the catching of whales, whose oil is become a staple commodity of the country; — *whales*, I say, which living and moving islands do find way to this coast, where, notwithstanding the desperate hazards run by the whale-catchers in their whale boats,— often torn to pieces by the strokes of the enraged monsters, yet it has rarely been known that any of them have miscarried." [2]

Whaling Accidents.— Fatalities did, however, occasionally overtake the whalemen. What was evidently an accident to a boat's crew of Indians in the pursuit of a whale off the Connecticut coasts, is thus referred to by Wait Winthrop of Boston, in a letter to his brother Fitz-John at New London, dated 29 Apl., 1700: "I am sorry for the accident about the two Indians, who I suppose to be lost tho' you do not say so, and tis well the others escaped. If there should be any difference about the pumme [*i. e.* possession] of the whale, I doubt I must com and hold a court of admiralty about it." [3]

In the diary of Rev. Simon Bradstreet, of New London, Conn., is a brief mention of the death of one Jonathan Webbe who, in October, 1668, was drowned in Boston Harbor while "catching a whale below the Castle. In coiling vp ye line vnadvisedly he did it about his middle thinking the whale to bee dead, but suddenly shee gave a Spring and drew him out of the boat, he being in ye midst of the line, but could not be recovered while he had any life." Probably the unfortunate man became caught in the harpoon line, though it is unlikely that he "did it about his middle," for the diarist adds in a parenthesis: "Mr. Webb's death, as after I was better informed, was not altogether so as related." [4]

In the Boston News-Letter for December 8, 1712, is an item from Marshfield, Mass., dated November 28: "On Tuesday, the 25th currant, six men going off the Gurnet Beach in a whale boat at Duxberry after a whale, by reason of the Boisterousness of the sea, oversetting the Boat,

[1] Crapo, W. W. Centennial in New Bedford, 1876, p. 27.
[2] Freeman, F. History of Cape Cod, 1862, vol. 2, p. 631, footnote.
[3] Coll. Mass. Hist. Soc., 1892, ser. 6, vol. 5, p. 61 (Winthrop Papers).
[4] New England Hist. and Geneal. Register, 1855, vol. 9, p. 44.

they were all drowned." [1] Again, in 1716, we learn that Mr. Jonathan Howes, who seems to have been prominent in the whaling enterprise at Yarmouth, "was killed by a whale which he attacked in a boat." [2]

Starbuck [3] further quotes a petition to the General Court, on file at the Boston State House in which Dinah Coffin, of Nantucket, prays to be allowed to marry again, inasmuch as, two years before, "her Husband, Elisha Coffin did on the Twenty Seventh Day of April Annoq Dom: 1722 Sail from sd Island of Nantucket in a sloop: on a whaling trip intending to return in a month or six weeks at most, And Instantly a hard & dismall Storm followed; which in all probability Swallowed him and those with him up: for they were never heard of." The Boston News-Letter of February 12, 1730 (quoted by Starbuck, 1878, p. 31) contains the record of a similar mishap near Chatham: "There has been a remarkable Providence in the awful death of some of my neighbors; On the day commonly called New Year's Day a whaleboat's Crew (which Consists of a Stersman, an Harpineer, and Four Oarmen) coming home from a Place called Hog's-Back, where they had been on a Whaling design, the Boat was overset, and all the Men lost, on a reaf of Sand that lies out against Billingsgate. When the Boat was found bottom upward, and the Stern post broken off, there were two Chests found in it, which were wedged so fast under the Thwards that the water had not washed them out; in which were found the Pocket books of two of the Men, by which it plainly appears what Boat it was; but none of the Bodies are, as yet found, that I can hear of; tho' they found an iron Pot, which they had with them, upon the reaf, and discovered the Whaling Irons at the bottom of the Water, where it is about 8 feet deep.

"P. S.— Before I had done writing I had News that two of their Bodies were found."

Of interest further in showing how the whale fishery at Cape Cod offered employment for men all about the Bay, is a brief item in the History of the Town of Hingham, Mass. (1893, vol. 3, p. 53), concerning John Marble, a native of that place, who died in April, 1738, as the record says, "suddenly at Cape Cod a whaling, leaving three small children."

An anecdote of early whaling, with less serious outcome, is told by Zaccheus Macy [4] in his account of Nantucket. "It happened once, when there were about thirty boats about six miles from the shore, that the wind came round to the northward, and blew with great violence, attended with snow. The men all rowed hard, but made but little headway. In one of the boats were four Indians and two white men. An old Indian in the head of the boat, perceiving that the crew began to be disheartened, spake out loud in his own tongue. . . . 'Pull ahead with courage; do not be disheartened; we shall not be lost now; there are too many Englishmen

[1] Quoted in J. Winsor: History of Duxbury, Mass., 1849, p. 86.
[2] Swift, F. C. History of Old Yarmouth, Mass., 1884, p. 136.
[3] Starbuck, A. Rept. U. S. Comm. Fish and Fisheries, 1878, p. 23, footnote.
[4] Coll. Mass. Hist. Soc., 1810, ser. 1, vol. 3, p. 157.

to be lost now.' His speaking in this manner gave the crew new courage. They soon perceived that they made headway; and after long rowing they all got safe on shore."

The pursuit of whales often carried the shore-whalers well away from land in these early days, and the above instance no doubt reflects what was of frequent occurrence. Many a long, hard pull they had to bring them back to land, and nightfall often caught them ere they made the shore.

Samuel West [1] refers to an old tradition that "it was common to see a light upon Gay Head in the night time. Others informed me, that their ancestors have told them, that the whalemen used to guide themselves in the night by the lights that were seen upon Gay Head." These lights were thought to be of supernatural origin, but may have been kindled by the Indians encamped there.

Accidents also happened at times to whalemen on land. Thus in the Boston News-Letter of July 23, 1741, it is related that a Mr. Nathaniel Hardy, of Truro, "an elderly Man of this Place, being at one of the Fry Houses boiling of Oil, he was taken with a fainting Fit, and fell into a large Vessell of boiling hot Oyl, and was scalded in a most miserable Manner." [2]

Ministers' Salaries.— The pious settlers of Plymouth seem to have been not unmindful of Heaven's benefaction in supplying them so "great store" of whales, for in June, 1662, we find that "the Court proposeth it as a thing they Judge would bee very comendable and beneficiall to the Townes where Gods Providence shall cast any whales; if they should agree to sett apart some p[ar]te of euery such fish or oyle for the Incurragement of an able Godly Minnester amongst them." [3] This praiseworthy suggestion evidently found favor among some at least of the towns, for in that same year, 1662, the town of Eastham voted that a part of every whale cast ashore should be appropriated for the support of the ministry.[4] A number of years later, we find it recorded that in 1702, the town of Sandwich gave to Rev. Roland Cotton "all such drift-whales as shall during the time of his ministry in Sandwich, be driven or cast ashore within the limits of the town, being such as shall not be killed with hands." [5] The same year Rev. John Cotton at Yarmouth received "incurragement" to the extent "of £40 in money, of the product of the whale fishes that came to this town the last year,— the town to have the balance." [6]

Strife over Drift Whales.— Despite the numerous regulations passed for the prevention of controversy, the strife over drift whales seems to have continued with energy. In 1693, the town of Sandwich was "in controversy with the Sheriff of the county, 'he having seized

[1] West, Samuel. A Letter concerning Gay Head. Mem. Amer. Acad. Arts and Sci., 1793, vol. 2, p. 150.
[2] Quoted by Starbuck, 1878, p. 33.
[3] Records of the Colony of New Plymouth, 1861, vol. 11, p. 135.
[4] Pratt, E. History of Eastham, Wellfleet, and Orleans, 1844, p. 33.
[5] Freeman, F. History of Cape Cod, 1862, vol. 2, p. 85.
[6] Ibid, p. 206.

in right of the Crown two whales on shore at Town-Neck'"[1] This evidence of friction between the zealous officials of the Crown, and the local whalers is further seen in an earnest and quaintly misspelled communication from a certain William Clapp, who made complaint to Governor Paul Dudley at Boston, that many 'drift' whales were unlawfully appropriated by the whalers to their own uses, for he had "very often every year sien that her maiesty has been very much wronged of har dues by these contry peple and other whall men as coms hear a whallen every year which tacks up drift whals which was neuer killed by any man which fish i understand belongest to har magiesty and had i power i could have seased severl every year."[2] It does not appear, however, that the irate official was given the power he desired to seize such whales for the Crown. Governor Dudley, nevertheless, seems to have taken matters into his own hands, and in 1705 retaliates by seizing certain whales taken by boats, "under a Pretence of drift fish." He refuses to try the questions at common law but decides the matter in the Admiralty.[3] Notwithstanding these frequent records of controversy, we are not to suppose that they are more than an occasional discordant echo of an important and flourishing industry.

Try-houses, in which the blubber of whales killed was boiled, and the oil prepared, seem to have been set up in many of the towns. A small tax was imposed for this privilege, and in 1701, Constant Freeman and Benjamin Small were appointed a committee on behalf of the town of Truro, "to look after such persons as shall set up whale-houses, or other houses, upon any of the common or undivided lands belonging to Pamet," and "to agree with them....for not less than 1s. per man."[4]

As early as 1706, an attempt was made to utilize the carcasses of stranded whales after the blubber was stripped. For in this year certain of the people of Eastham and thereabouts, addressed a petition to the General Court on the behalf of one Thomas Houghton, of Boston, or his assigns, that for the space of ten years, he be allowed the exclusive privilege in New England of carrying off such waste and putting it to some profitable use. This petition sets forth that "all or most of us are concerned in fitting out Boats to Catch & take Whales when ye season of ye year Serves: and whereas when wee have taken any whale or whales, our Custom is to cutt them up, and to take away ye fatt and ye Bone of such Whales as are brought in, And afterwards to let ye Rest of ye Boddy of ye Lean of whales Lye on shoar in lowe water to be washt away by ye sea, being of noe vallue nor worth any Thing to us"; wherefore it is desired that Houghton apply his 'discovery' to the great profit of the people concerned. The Council in granting his patent, stipulates "that within the space of Four years he shew forth to the Satisfaction of the Govern[r] Council & Assembly That his Projection will take effect,

[1] Freeman, F. History of Cape Cod, 1862, vol. 2, p. 82.
[2] Ibid., vol. 1, p. 342, footnote.
[3] Coll. Mass. Hist. Soc., 1879, ser. 5, vol. 6, quoted by Weeden, Economic and Social History of New England, 1890, vol. 1, p. 436.
[4] Freeman, F. History of Cape Cod, 1862, vol. 2, p. 543.

for the rayseing of Salt Petre to supply the province"![1] Nothing more seems to be known of this interesting 'projection,' and it is doubtful if anything came of it.

Employment of Cape Cod Indians.— So important was the whale fishery in these years that it probably constituted the chief employment of many colonists as well as Indians during the winter season, from November till May. So in 1724–25, during the Indian wars, some of the friendly Indians from Cape Cod were enlisted, but with the express understanding that they be discharged in time for the commencement of the whaling in the fall. "Accordingly in 1724, Lieutenant-Governor Dummer, of the Massachusetts Bay, writes to Colonel Westbrook; 'Upon Sight hereof you must forthwith dismiss Cpt. Bournes Comp^{y} of Indians & send them hither in one of the Sloops, That so they may lose no Time for Following the Whale Fishery, w^{ch} is agreeable to my Promise made to them at enlisting.' In a postscript he adds: 'Let Capt. Bourne come with them to see them safe return'd.' And again, in 1725, the Secretary writes: 'His Hon^{r} Having promised the Indians enlisted by Cpt. Bourne (being all those of the County of Barnstable) to dismiss them in the Fall that so they attend their Whale Fishing; directs that you as soon as you have opportunity to send them up to Boston, in Order to their Return Home, & let none of them be detained on any Pretense whatsoever.'"[2] It is gratifying to find at least this slight evidence that our forefathers occasionally dealt truly with their Indian neighbors.

Decline of the Cape Cod Whaling.— The end of the first quarter of the eighteenth century seems to have marked the decline of shore whaling on the coast of New England. Relentless pursuit for nearly a century had finally killed or driven off the whales that frequented our shores. Thus, in the Boston News-Letter of March 20, 1727, is the following very significant item: "We hear from the Towns on the Cape that the Whale Fishery among them has failed much this Winter, as it has done for several Winters past, but having found out the way of going to Sea Upon that Business, and having had much Success in it, they are now fitting out several Vessels to sail with all Expedition upon that dangerous Design this Spring, more (its tho't) than have ever been sent out from among them" (quoted by Starbuck, 1878, p. 31).

The whalers, as always with seamen, believed that the whales had merely moved to other grounds, and consequently were ready to follow them. As a matter of fact, however, it is probable that the Right Whales of the western North Atlantic were so very greatly reduced in numbers that they have never been able to recover their former abundance. A similar relentless pursuit had nearly exterminated them in the eastern part of the North Atlantic.

Of the decline of the whale fishery on our coasts, various echoes are found in items (quoted by Starbuck, 1878, p. 32–34) from files of the Boston News-Letter during these years. Thus in the season of 1737–8, the local whalers at Provincetown had killed up to January 5, 1738,

[1] Mass. Col. MSS., Maritime, vol. 4, p. 72–73; quoted by Starbuck, 1878, p. 30–31.
[2] Mass. Col. MSS., vol. 2, p. 297; quoted by Starbuck, 1878, p. 31.

but two small whales. By February of the same year, the whalers at Yarmouth had taken but one large whale, the baleen of which was eight or nine feet long. That spring, in order to make up for this loss, a dozen vessels, carrying most of the men of Provincetown fitted out for the fishery in Davis Straits. The following year was hardly more productive: for the entire season's catch at Cape Cod was six small whales and one large one at Provincetown, and two small ones at Sandwich. As a result, "many of the people of Provincetown were in straitened circumstances and much distressed.....Many of them were without money or provisions."

A note in the Boston Post Boy of February, 1739, confirms these statements: "We have advice from Province-Town on Cape Cod, that the whaling season is now over with them, in which there has been taken in that Harbor six small whales and one of a larger size about six foot bone: beside which 'tis said two small whales have been killed at Sandwich which is all that has been done in that business in the whole Bay. 'Tis added, that seven or eight families in Province-Town, among whom are the principal inhabitants, design to remove.... to Casco Bay in the spring" — as a result, we may infer, of the failure of the whale fishery.

That so large a proportion of the whales caught at this time were small, is a fact of much interest, and probably indicates that the adults had been nearly extirpated, for the largest whales are ever the ones most keenly sought. The destruction of the adults of course prevented a normal increase, and the small animals, too, were hardly allowed to reach maturity.

It seems likely that right-whaling was practically abandoned at Cape Cod by 1750. Douglass, in 1749, wrote of whales, that "formerly Cape Cod embayed them, but being much disturbed....they kept a good offing." He seems to have accepted the notion then prevalent, that the animals had simply sought other waters. He speaks also of a whale, stranded back of Cape Cod, that yielded 134 barrels of oil and a proportionate weight of bone. "This whale was so fat that some poor people tried the muscular flesh, and made 30 bls. of oil." [1] On February 10, 1755, at Truro, the appearance of a whale in the bay was sufficient to call out the greater part of the male population, so that it became necessary to adjourn until the following day, a town meeting called to hear and act on the reply of a Rev. Caleb Upham, called to that Parish.[2] In 1757, the town of Eastham "chose a committee to prosecute the Harwich people for carrying on the whale fishery at Billingsgate," [3] so that it is clear that the local industry was still surviving at this date. But since there is certain evidence that Humpback Whales were then pursued in those waters, it is unsafe to conjecture how far the Right Whale was therein concerned. It further appears that in 1763 Billingsgate was incorporated with Wellfleet and it was agreed that the two towns should equally enjoy the privileges of whaling and

[1] Freeman, F. History of Cape Cod, 1862, vol. 2, p. 623.
[2] Freeman, F. History of Cape Cod, 1862, vol. 2, p. 558.
[3] Pratt, E. History of Eastham, Wellfleet, and Orleans, 1844, p. 70.

fishing as before.[1] Of the whaling, however, there was little left to 'enjoy.' The Reverend Mr. Mellen, who in 1794 wrote a Topographical Description of the Town of Barnstable,[2] said in retrospect, that "seventy or eighty years ago, [*i. e.*, about 1714–1724] the whale bay fishery was carried on in boats from the shore, to great advantage: This business employed near two hundred men, for three months of the year, in the fall and beginning of winter. But few whales now come into the bay, and this kind of fishery has for a long time (by this town at least) been given up." Freeman, likewise, recalls that "the shores of the Cape were, within the remembrance of persons now [1862] living, strewed in places with huge bones of whales, these remaining unwasted many years. Fifty years back [about 1810], rib-bones set for posts in fencing, was no unusual sight." [3]

In 1774, ships from Nantucket first crossed the equator in pursuit of whales, and in 1791, the first American whaler rounded Cape Horn into the untried whaling 'grounds' of the Pacific. The pursuit of Right Whales on the New England coast was never again taken up in a regular manner. At intervals even to the present day, an occasional solitary specimen or even a small school appears off the shores of Nantucket or the outer portion of Cape Cod, and not infrequently have the fishermen of these coasts given successful pursuit in their small boats with harpoon or bomb-lance. But such occurrences are now the exception, and the people have long since passed to other pursuits.

Methods of whaling.— While at first whales were pursued in small boats from the shore, the 1662 citation above given in which reference is made to the cutting up of whales at sea, implies that already at that date small vessels were used to pursue the quarry offshore in addition to the whale boats kept in readiness for launching from the beach. Cutting up the whale at sea in calm weather was probably quite as easy a process as towing the great carcass to land. For the Right Whale nearly always floats when dead, and with block and tackle the stripping off of the sheets of blubber must have been comparatively easy. Then too the great body could more readily be rolled over as it floated in the water. The shore whaling was thus supplemented by the use of sailing vessels of small burthen. The method of stationing watchers along the coast during the whaling season, to give notice to the boat-whalers was much employed on Cape Cod. Thus at Yarmouth, from the earliest period of its history, "a tract of land has been reserved for the use of the inhabitants, and known as the Whaling Grounds. It is situated in the northwesterly part of the town of Dennis, and is still [1884] held in common by the two towns. There is no record of the laying out of these lands, but by the references made to them in various documents, it appears that they were undoubtedly laid out by the early proprietors of the town, for a look-out for those watching for whales. In 1713, the

[1] Freeman, F. History of Cape Cod, 1862, vol. 2, p. 361.
[2] Coll. Mass. Hist. Soc., 1794, ser. 1, vol. 3, p. 12–17.
[3] Freeman, F. History of Cape Cod, 1862, vol. 2, p. 623.

proprietors enlarged the reservation by adding about two acres at the West end, doubtless that the whalemen might have a convenient place to fill water. Upon this reservation a house or houses were erected, in which the whalemen lived, and a watch was kept up to notify the crews when the whales appeared....The boats were sometimes manned by the native Indians, who were remarkably well adapted for the business. Mr. Jonathan Howes, a grandson of the first Thomas, derived sufficient profit in one fortunate season's whaling, with a company of these Indians, to pay for a large two-story house which he built, and which was standing" till about 1864.[1]

According to Justin Winsor,[2] "schooners, sloops and perhaps larger vessels were engaged in the whale fishery from Duxbury as early as the beginning of the last [*i. e.*, eighteenth] century, and for some years quite a number of the inhabitants were thus employed. Their resort was at first along the shore and between the capes [Cape Ann and Cape Cod]; but by the close of the first quarter of the century they had extended their grounds" even to the coast of Newfoundland and the Gulf of St. Lawrence, where they probably found also the Arctic Bowhead. Winsor further mentions an old account book of Mr. Joshua Soule of Duxbury, with the memorandum: "Whale vieg [voyage] begun. elisha cob sayled from hear March y^{e} 4, from Plymouth y^{e} 7, 1729." [2] The extent of this cruise may well have been outside of New England waters, but apparently was begun in Massachusetts Bay, at the time when Right Whales were on the coast.

In 1725, Paul Dudley of Boston, communicated to the Royal Society an account of the whales of New England with notes on their habits and capture. This was published in the Philosophical Transactions of that year. He says (I quote the 1734 Abridgment): "I would take notice of the Boats oure Whale-men use in going from the Shoar after the Whale, They are made of Cedar Clapboards, and so very light, that two Men can conveniently carry them, and yet they are twenty Feet long, and carry six Men, *viz.* the Harponeer in the Fore-part of the Boat, four Oar-men, and the Steersman. These Boats run very swift, and by reason of their Lightness can be brought on and off, and so kept out of Danger. The Whale is sometimes killed with a single Stroke, and yet at other Times she will hold the Whale-men in Play, near half a Day together, with their Lances, and sometimes will get away after they have been lanced and spouted Blood, with Irons in them, and Drugs fastened to them, which are thick Boards about fourteen Inches square. Our People formerly used to kill the Whale near the Shore; but now they go off to sea in Sloops and Whale boats." [3] It is evident that the small vessels employed for taking whales at sea, simply stripped the blubber and whalebone and cast the body adrift, for this same writer remarks: "The Carcases of Whales in the Sea, serve for

[1] Swift, F. C. History of Old Yarmouth, Mass., 1884, p. 113.
[2] Winsor, J. History of Duxbury, Mass., 1849, p. 350.
[3] Dudley, P. Phil. Trans. Roy. Soc. London, Abridged, 1734, vol. 7, pt. 3, p. 427.

Food for Gulls, and other Sea-Fowl, as well as Sharks, for they are not very nice." [1] The use of "Drugs" or drags made of heavy plank and attached so as to be pulled broadside through the water, must have materially aided in tiring out the whale so as to allow of approaching near enough to lance. William Douglass, in his Summary, Historical and Political,....of the British Settlements in North America (London, 1760, vol. 1, p. 296–298) further describes this "drudge or stop-water" as a "plank of about two feet square, with a stick through its center; to the further end of this stick, is fastened a tow-rope, called the drudge rope, of about fifteen fathom; they lance, after having fastened her by the harpoon, till dead."

For the harpoon line, hempen cord was used. This line or "fast," according to Douglass, "is a rope of about twenty-five fathom." In the Boston News-Letter of December 5, 1723, Mr. Peter Butler advertises for sale, at that place, "lately imported from London, extraordinary good Whale Warps at 16^{d} a Pound, which are made of the finest Hemp, either by the Quoile or less Quantity" (Starbuck, 1878, p. 34).

Early Whaling at Cape Ann.— To the historian J. B. Felt, we are chiefly indebted for what fragmentary references there are as to the early whaling industry at Cape Ann, Massachusetts, and the adjacent waters. He mentions [2] in his History of Salem, that James Loper of that town, in 1688, petitioned the colonial government of Massachusetts for a patent for making oil. In his petition Loper sets forth that he has been engaged in whale-fishing for twenty-two years, but whether from Salem or elsewhere does not appear. Starbuck, who quotes this incident, is at some pains to show that this is probably not the James Lopar of Long Island whom the people of Nantucket, in 1672, invited to undertake "a design of Whale Citching" from their shores.

As elsewhere mentioned, whaling was carried on in Massachusetts Bay with the aid of small sailing vessels, at least as early as 1662, and it seems certain that these vessels pursued Right Whales in the waters off Cape Ann, and southward. For John Josselyn,[3] writing in 1675, describes the Ipswich River, how it "issueth forth into a large *Bay*, (where they fish for *Whales*) due East over against the Islands of Sholes."

Somewhat later, it appears that vessels cruised from Salem to Cape Cod after these whales, for on March 12, 1692, John Higginson and Timothy Lindall, of Salem, wrote to Nathaniel Thomas: "We have been jointly concerned in severall whale voyages at Cape Cod, and have sustained greate wrong and injury by the unjust dealing of the inhabitants of those parts, especially in two instances: ye first was when Woodbury and company, in our boates, in the winter of 1690, killed a large whale in Cape Cod harbour. She sank and after rose, went to sea with a harpoon, warp, etc. of ours, which have been in the hands of Nicholas Eldredge.

[1] Dudley, P. Phil. Trans. Roy. Soc. London, Abridged, 1734, vol. 7, pt. 3, p. 429.
[2] Felt, J. B. History of Salem, 1845, vol. 2, p. 224.
[3] Josselyn, J. Two Voyages to New England, 1675, reprinted in Coll. Mass. Hist. Soc., 1833, ser. 3, vol. 3, p. 323.

The second case is this last winter, 1691. William Edds and company, in one of our boates, struck a whale, which came ashore dead, and by ye evidence of the people of Cape Cod was the very whale they killed. The whale was taken away by Thomas Smith of Eastham, and unjustly detained." [1] Thus it seems that the people of Cape Cod rather resented this intrusion of outsiders into their home waters. In 1700, John Higginson again writes: "We have a considerable quantitie of whale oil and bone for exportation." [1]

Again, under date of December 10, 1706, the same John Higginson of Salem, writes to Symond Epes of Ipswich: "I hear a rumor of several whales, that are gotten. I desire you to send me word how much we are concerned in them, and what prospect of a voyage. When they have done, I desire you would take care to secure the boats and utensils belonging to them." [2] Apparently the reference is to Right Whales killed from boats off the coast of Ipswich, and since the whaling season is then just beginning, Mr. Higginson, who appears to be backing the undertaking, is anxious that a vessel should be fitted out for a cruise in the nearer waters. Hence the necessity for securing what "boats and utensils" there may be available. In the following year, September 22, 1707, Mr. Higginson again writes about whale-boats and crews at Ipswich, and remarks, "We should be in readiness for the noble sport." [2] As the whaling season was then less than two months off, Mr. Higginson's foresight is well exemplified.

Probably "Whale Cove" at Rockport owes its name to some incident connected with the capture of the Right Whale there in the early days.

Whales occasionally came even into Boston Harbor in Colonial times, and Starbuck makes mention of certain whaling gear that apparently was kept in readiness against the appearance of these animals. In October, 1668, Jonathan Webb, was drowned while capturing a whale "below the Castle" [*i. e.* Castle Id.],[3] in Boston Bay, and the Boston newspapers of December 12, 1707, describe the pursuit and capture of a whale forty feet long in the harbor, near the back of Noddle's Island.[4]

Whaling at Nantucket and Martha's Vineyard.— At the time of the settlement of Nantucket and for many years thereafter Right Whales seem to have been common during their northward and southward passages in the neighboring seas. At first no attempt seems to have been made to capture them, but those that drifted ashore were eagerly seized and utilized. In the middle of the 17th century the Cape Cod colonists had actively undertaken their pursuit, so that it is not unlikely that the number of 'drift whales' that fell to the share of the Nantucketers at this time, was partly an indirect result of their neighbors' efforts. For many were probably whales that had been struck and lost. The inevitable quarrels over the owner-

[1] Felt, J. B. History of Salem, 1845, vol. 2, pp. 224, 225.
[2] Felt, J. B. History of Ipswich, Essex and Hamilton, 1834, p. 109.
[3] New England Hist. and Geneal. Register, 1855, vol. 9, p. 44.
[4] Starbuck, 1878, p. 34.

ship and partition of these valuable prizes soon made it necessary to enact laws for the prevention of such disputes. The Indians, who seem to have been well treated by the Nantucket colonists, coöperated with them in their efforts to discover and utilize 'drift' whales. The records have it that in 1668, the English of Nantucket made "a bargaine with ye Indians concerning all whales" that should drift to the shores of the island. Subsequently the shores were divided into sections, over which Indian sachems were appointed to oversee the cutting up of stranded whales and to divide the shares. That this method did not always give satisfaction to the rival claimants appears from the record of appeals to the island Courts. So we find in one case, "the Court do order that the Rack or drift Whale in the bounds of the bech upon the playnes shall be divided into eight shares," and that "no Rack Whale that com ashore in any sachems bounds shall be cut up until all the masters of the shares that belong to that Whale do com together" implying that even the sachems were not beyond temptation. Sometimes the Court went into particulars,[1] as when it ordered "that Washaman is to have the head of the drift Whale for his share and Desper is to have halfe along with him." Again, a jury of six men tried a complaint of the Indian "Massaquat against Eleaser Foulger for stealing his Whale." The defendant confessed that he "did dispose of the Whale in controversie," and the Court sentenced him "to pay for the Whale the summe of four pounds in goods at the usual price of trading." No doubt the Court in its decisions between Indians and Englishmen, may have been somewhat over lenient towards the latter, but one is hardly prepared to find that a Nantucket Indian, for stealing eighteen slabs of whalebone, was condemned to serve Thomas Macy for seven years![2]

At about 1672 Nantucket undertook its first whaling enterprise. According to Macy, the local tradition had it that a Right Whale of the sort called 'scrag' (*i. e.* runt), came into the harbor and continued there three days. This proved too much for the hunting instinct of the settlers, who wrought a harpoon and with it succeeded in killing the whale. Whales appear to have then been common at certain seasons, especially off the seaward side of the island. The Nantucketers very wisely decided to call to their aid one James Lopar of Long Island, who was granted certain privileges in return for his undertaking to manage a whaling industry. The original agreement is given verbatim by Macy[3] as follows:

"5th 4th mo. 1672 James Lopar doth Ingage to carry on a design of Whale Citching on the Island of Nantucket, that is the said James Ingage to be a third in all respeekes, and som of the Town Ingage Also to Carrey on the other two thirds with him in like manner, the Town doth also Consent, that first one Company shal begin and afterward the rest of the freeholders or any of them, have liberty to set up an other Company Provided that they make a tender

[1] Bliss, W. R. Quaint Nantucket, 1896, pp. 11, 12.
[2] Ibid., p. 70.
[3] Macy, O. History of Nantucket, 1835, p. 28.

to those freeholders that have no share in the first Company and if any refuse, the Rest may go on themselves, and the Town do also Ingage that no other Company shal be allowed hereafter, Also whosoever Kil any whale of the Company or Companys aforesaid they ar to pay to the Town for every such Whale five Shillings — and for the Incorragement of the said James Lopar the Town doth grant him Ten Acres of Land in som convenant place, that he may Chuse in, (Wood Land exceped) and also Liberty for the Commonge. of thre Cows and twenty Sheep and one horse with necessary Wood and water for his use on Conditions that he follow the Trade of Whaleing on the Island two years in all the season thereof, beginning the first of March next insuing. Also is to build upon his land, and when he leaves Inhabiting upon the Island then he is first to ofer his Land to the Town at a Valluable price, and if the Town do not buy it — then he may Sel it to whome he please — the commonage is granted only for the time he stays here." This James Lopar is thought by Starbuck (1878, p. 16) to be with little doubt the same person that he mentions as engaged in whaling on the Long Island shores at this time. There is no evidence to show that Lopar did actually avail himself of the proposition thus made to him, although a cooper named John Savidge, who was offered a similar concession, apparently did come to "follow his trade of cooper upon the island as the town or whale Company have need to employ him." It was nearly twenty years later, in 1690, that the people of Nantucket employed Ichabod Paddock to come from Yarmouth, and instruct them in killing whales and trying out the oil. It was in this same year, according to a cherished local tradition, that one of a company of persons who were watching the whales from the top of the present Folly House Hill, pointed to the sea and observed with prophetic vision, "There is a green pasture where our children's grandchildren will go for bread."

It appears that at first the whaling operations were, as elsewhere, carried on in boats from the shore, and that occasionally, in pleasant weather during the winter season, the whalers ventured off nearly out of sight of land. A description of this is given by J. Hector St. John Crèvecoeur who, in 1782, published at London some "Letters from an American Farmer." He tells us that after the beginning of the shore fishery at Nantucket, "the south sides of the island from east to west, were divided into four equal parts, and each part was assigned to a company of six, which though thus separated, still carried on their business in common. In the middle of this distance, they erected a mast, provided with a sufficient number of rounds, and near it they built a temporary hut, where five of the associates lived, whilst the sixth from his high station carefully looked toward the sea, in order to observe the spouting of the whales. As soon as any were discovered, the sentinel descended, the whale-boat was launched, and the company went forth in quest of their game." [1] The same writer further says that the Right Whale was common and was known to the Nantucketers as the 'seven-foot-bone' from the length of its longest plates of baleen. Its numbers, however, must have speedily declined,

[1] St. John Crèvecoeur, J. Hector. Letters from an American Farmer. London, 1782; reprint, 1904, see p. 159.

and the whalers at the same period were yearly voyaging to greater distances from home. Indeed, Starbuck tells us that already by 1732, New Englanders were whaling in Davis Straits.

In 1720, the people of Nantucket ventured to send a small shipment of oil to London, and this was soon followed by more, so that ere long commenced an important traffic. The original bill of lading of this first shipment dated at Boston, the 7th of April, 1720, is quoted by Starbuck (1878, p. 20):—

"Shipped by the grace of God, in good order and well conditioned, by Paul Starbuck, in the good ship called the Hanover, whereof is master under God for the present voyage, William Chadder and now riding in the harbour of Boston, and by God's grace bound for London; to say:— six barrels of traine oyle, being on the proper account & risque of Nathaniel Starbuck, of Nantucket, and goes consigned to Richard Partridge merchant in London. Being marked & numbered as in the margin & to be delivered in like good order & well conditioned at the aforesaid port of London (The dangers of the sea only excepted) unto Richard Partridge aforesaid or to his assignees, He or they paying Freight for said goods, at the rate of fifty shillings per tonn, with primage & average accustomed.

"In witness whereof the said Master or Purser of said Ship hath affirmed to two Bills of Lading all of this Tener and date, one of which two Bills being Accomplished, the other to stand void.

"And so God send the Good Ship to her desired Port in safety, Amen!

"Articles & contents unknown to —

(Signed) William Chadder."

The Nantucket Indians who from the first had been treated with consideration, were largely employed in this early whaling. Macy[1] tells us that nearly every boat was manned in part, many almost entirely, by them, so that, as at Cape Cod, they soon became experienced whalemen. After killing the whale, they towed it ashore, for the Right Whale usually floats when dead, and the blubber was then stripped off by the aid of a sort of windlass called a 'crab.' The blubber was carried in carts to the try houses which then were near the dwellings of the settlers. Of the numbers of whales taken in the Nantucket waters in these years almost nothing is recorded. Macy says that the greatest number ever killed and brought to shore in a single day was eleven, and the greatest number killed in any year was in 1726 when no less than eighty-six were captured. These figures will serve to indicate the abundance of Right Whales on the coast in those times.

In addition to boat whaling from the shore stations, it is certain that at an early date, larger vessels were sent out to pursue the Right Whale in the offshore waters at no great distance from port. It was one of these vessels, that about 1712, while cruising for Right Whales near shore, was blown by a strong northerly wind some distance from land. A school of Sperm

[1] Macy, O. History of Nantucket, 1835, p. 30.

Whales was discovered and the crew succeeded in killing one and bringing it back to the island. Following the example thus set, a number of vessels were shortly fitted out and sent on cruises of six weeks or so, and these on capturing whales, returned at once with the blubber, for trying out. These vessels usually carried two boats, one of which was held in reserve while the other was sent to attack the whale. To facilitate the landing of the spoil and the rendering of the oil, try-houses were erected near the landing, so that the vessel might at once discharge her cargo and return to the chase. Gradually, as the Right Whales diminished in the vicinity of Nantucket, the vessels went farther and farther afield. About 1760, says Nantucket's historian, their numbers had so greatly decreased, that their pursuit in the home waters was gradually abandoned. With the increasing development of the sperm whaling came the fitting out of larger vessels for the uncharted seas of distant parts of the world. During the last century, the records as elsewhere detailed, still show the occasional occurrence of Right Whales off the coast of Nantucket but for many years no special effort was made to capture these stray individuals. In 1886, however, the appearance of several Right Whales near at hand, roused again the whaling blood of the islanders, boats and harpoons were hastily prepared and three or four whales were eventually killed. Since then as I am told by one of the townspeople, a boat is kept in readiness at Tuckernuck and on Nantucket, should a Right Whale appear, but years may now pass without ever a spout to call forth the hunters.

Martha's Vineyard.— In the Vinyard Gazette (quoted by Starbuck, 1878, p. 17) occurs the earliest mention of whaling at Martha's Vineyard. This was in November, 1652, "when Thomas Daggett and William Weeks were appointed 'whale cutters for this year.' The ensuing April it was 'Ordered by the town that the whale is to be cut out freely, four men at one time, and four at another, and so every whale, beginning at the east end of the town.'" This appears to signify that, beginning with the householders at the east end of the town, the first four should take charge of the first whale cast ashore, and should 'save' its oil for the town free of cost. The next four men in like manner were to attend to the next that should come, and so all would take their turn in working for the common good. It is therefore to be inferred that the appointment of but two 'whale cutters' the previous year had proved insufficient. From the same source, we are informed that in 1690, "Mr. Sarson and William Vinson were appointed by 'the proprietors of the whale' to oversee the cutting and sharing of all whales cast on shore within the bounds of Edgartown, 'they to have as much for their care as one cutter.'" Probably, then, as at Cape Cod, it had later become convenient to give the entire charge of saving 'drift' whales into the hands of a certain few persons, who in return paid the town a rental, and made what profit they might. Such were the "proprietors of the whale." No doubt these gentlemen, eager for a large return, did not take extraordinary pains to ascertain whether such dead whales seemed to have died from natural causes (and so were a legitimate prey) or were marked by harpoons or lance thrusts so as to be identifiable by the whalers

who had actually killed them and might thus rightly claim the blubber. Starbuck (1878, p. 18) finds, thus, in 1692 a case of "the inevitable dispute of proprietorship. A whale was cast on shore at Edgartown by the proprietors, 'seized by Benjamin Smith and Mr. Joseph Norton in their behalf,' which was also claimed by 'John Steel, harpooner, on a whale design, as being killed by him.' It was settled by placing the whale in the custody of Richard Sarson, esq., and Mr. Benjamin Smith, as agents of the proprietors, to save by trying out and securing the oil; 'and that no distribution be made of the said whale, or effects, till after fifteen days are expired after the date hereof, that so such persons who may pretend an interest or claim, in the whale, may make their challenge; and in case such challenge appear sufficient to them, then they may deliver the said whale or oyl to the challenger; otherwise to give notice to the proprietors, who may do as the matter may require.'" From these meager references we are to infer that whales were regularly hunted in the waters about Martha's Vineyard, and that they not infrequently drifted, dead, to the shores, usually no doubt, victims of a previous encounter with the whalemen. It became customary, in the event of the quarry escaping, for the whalers at once to put on record with the town clerk, the wounds of the whale and the marks of the harpoons that so it might be identified in case it drifted to land. Such an entry is quoted by Starbuck (1878, p. 35) from the Court records of Martha's Vineyard for the year 1702–03: "The marks of the whales killed by John Butler and Thomas Lothrop. One whale lanced near or over the shoulder blade, near the left shoulder blade only; another killed with an iron forward in the left side, marked W; and upon the right side marked with a pocket-knife T. L.; and the other had an iron hole over the right shoulder-blade, with two lance holes in the same side, one in the belly. These whales were all killed about the middle of February last past; all great whales, betwixt six and seven and eight foot bone, which are all gone from us. A true account given by John Butler from us, and recorded Per me, Thomas Trapp, Clerk."

Martha's Vineyard seems never to have been very prominent in whaling, and the few references that apply to the industry there after 1700 have to do mainly with deep-sea voyages, for the Right Whales were nearly exterminated in the adjacent waters by the first quarter of the eighteenth century, and by its close they were so scarce that a writer[1] in 1807 says: "But the whale, which was formerly so abundant on the coast, has almost disappeared....Two have been taken during the course of the last twenty years."

Early Whaling in Rhode Island.— In 1663, King Charles II granted a charter to the Rhode Island and Providence Plantations, which among other privileges, provides: "ffurther, for the encouragement of the inhabitants of our sayd Collony of Providence Plantations to sett vpon the business of takeing whales, itt shall bee lawefull ffor them, or any of them, having struck whale, dubertus [*i. e.*, Finback Whales], or other greate ffish, itt or them, to pursue unto

[1] Coll. Mass. Hist. Soc., 1846, ser. 2, vol. 3, p. 55.

any parte of that coaste, and into any bay, river, cove, creeke or shoare, belonging thereto, to kill and order to the best advantage, without molestation, they makeing noe wilfull waste or spoyle." [1]

To what extent the inhabitants of Rhode Island availed themselves of the whaling privileges thus granted, there seems to be little record. It may safely be inferred, however, that whaling was carried on in the adjacent waters, and that dead whales, probably in large part those previously wounded, were from time to time driven ashore by wind and tide. Here, as elsewhere, such flotsam was considered a perquisite of the Crown, provided that no proof could be shown that the whale had been harpooned by the whalers. But the Crown officers seem to have been rather lax in the administration of such prizes, until in 1686, at a town meeting at Westerly, March 24, it was "VOATED: that whereas sundry fish of considderable value have been formerly cast up within the confines of this towne, and have been monopolized by perticuler persons bellonging to other jurisdicttions, whereby his Majesty and subjects have been wronged of their just Rights and priviledges; And to protect the like for the future, The Towne doe order, That if any Whale, Dubertus, [a name applied to the Finback Whales] or other great fish of considerable value shall be cast up within the limmits of this Towne, the person or persons that shall first find it shall forthwith make the Authorities and Inhabitants acquainted with the same, that his Majesties Right may be secured, and the remainder to be equally divided among the inhabitants; and the person or persons so doeing shall be duly Recompensed for their paines.....And if any person or persons shall presume to break up any such fish or fishes, before publycation thereof, According to this order, he or they, or either of them, shall pay thirty pounds sterling as a fine to the towne, and return the fish that they have taken." [2] The "perticuler persons bellonging to other jurisdicttions" may well have been some of the more energetic whalers of Stonington or New London, who at this time were probably active in the shore fishery. The large amount of the fine (£30) imposed for breach of this order is indicative of the determination of the people at Westerly to permit no more 'drift' whales to be cut up and carried off by their brethren of neighboring towns. This order of 1686, it will appear, is practically the same in its tenor as the law that existed in 1652 in the Plymouth Colony, making the "drift fish" public property to be shared equally by the inhabitants, after the Crown had been accorded its due portion. That so few echoes of strife over the possession of whales are heard from Rhode Island is perhaps evidence that they were little pursued by the settlers of its shores.

After the devastating French and Indian Wars, attempts were made to stimulate the fishing industry, and in March, 1751, the General Assembly at Providence passed an act for encouraging the "whale and cod fishery within this colony." To this end a bounty of four shillings

[1] Records Colony of R. I. and Providence Plantations, 1857, vol. 2, p. 16.
[2] Denison, F. Westerly (Rhode Island), 1878, p. 223.

was allowed on every barrel of whale oil and one shilling on every pound of whalebone. The effect of this act is not apparent.

Whaling in Connecticut.— That whaling was begun or contemplated on the Connecticut shores shortly previous to 1650, is evidenced by a minute in the Colonial Records, (Public Records of Conn., 1850, vol. 1, p. 154), showing that the General Court at Hartford, on May 25, 1647, resolved that "Yf Mr. Whiting wth any others shall make tryall and p^{r}secute a designe for the takeing of Whale, wthin these libertyes, and if vppon tryall wthin the terme of two yeares, they shall like to goe on, noe others shalbe suffered to interrupt them, for tearme of seauen yeares."

This method of granting monopolies, we are informed, was the customary mode of encouraging enterprise at that early day.[1] Of Mr. Whiting's project, however, nothing further is known. It is probable, nevertheless, that whales frequently came into the eastern end of Long Island Sound, and there can be little doubt that the settlers on that part of the Connecticut sea board engaged at times in their pursuit. Caulkins[1] notes the mention of "a whaleboat" in an enumeration of goods at New London before the end of the seventeenth century. The same author quotes an old memorandum of January 13, 1717: "Comfort Davis hath hired my whale boat to go a whaling to Fisher's Island, till the 20th of next month, to pay twenty shillings for her hire, and if he stays longer, thirty shillings. If she be lost, and they get nothing, he is to pay me £3, but if they get a fish, £3, 10s." It is to be inferred that the expectation was not for a very large catch — "if they get a fish," the owner of the boat seems to think they shall have done as much as could reasonably be expected.

Probably Right Whales did not penetrate far into the Sound, but came now and then to its eastern end. Although Stonington and New London at about the middle of the nineteenth century became important whaling ports, their vessels of course cruised far from the home waters. No doubt local whaling declined here as elsewhere in eastern New England in the latter half of the seventeenth century. Linsley mentions that just previous to 1842 a school of Right Whales appeared in the waters off Stonington, whither one of them was later brought, while a second was killed by whalers from Montauk, Long Island. This would indicate that boats were still kept in readiness for the occasional appearance of the whales, but the industry had long since ceased to have local importance.

Yield of Oil and Baleen.

According to Collett (1909, p. 95) the amount of first quality oil yielded by this species varied from ten to thirty barrels in case of those captured of late years among the Hebrides. These amounts seem small, however, in comparison with those elsewhere recorded, which probably include the total amount of oil obtained.

[1] Caulkins, F. M. History of New London, Conn., 1852, p. 638.

Two Right Whales captured off Provincetown about the 20th of May, 1888, yielded together about 170 barrels of oil, an average of 85 (Nantucket Journal, vol. 10, no. 35, May 31, 1888).

A Right Whale killed off Nantucket in April, 1886, is said to have yielded about forty barrels of oil and 650 pounds of whalebone. The total yield from this and two others of about the same size, taken at this time, was about 125 barrels of oil and 1500 pounds of whalebone (Nantucket Journal, vol. 8, no. 31, Apl. 29, 1886; no. 32, May 6, 1886).

An unusually large and fat cow Right Whale, accompanied by a calf, was killed off Cape Cod about the first of June, 1888, and was estimated to yield about 100 barrels of oil and 1500 pounds of whalebone, worth at that time between $3000 and $4000 (Nantucket Journal, vol. 10, no. 36, June 7, 1888). The Right Whale, taken off Plymouth, Mass., in April, 1864, whose mounted skeleton is preserved in the Museum of Comparative Zoölogy, yielded eighty barrels and fourteen gallons of oil which was sold for $1.14 per gallon. The baleen taken from it weighed 1001 pounds and sold for $1.00 a pound.

According to Douglass [1] they "do yield not exceeding 120 to 130 barrels oil, and 9 feet bone 140 lb. wt." The Arctic Bowhead Whale yields from 400 to 500 barrels of oil.

Dr. F. W. True (1904) quotes the following from O'Callaghan's Documents relating to the Colonial History of New York, taken from a letter dated July 1, 1708, and addressed to the Lords of Trade by one Lord Cornbury: "a Yearling will make about forty Barrels of Oyl, a Stunt or Whale of two years old will make sometimes fifty, sometimes Sixty Barrils of Oyl, and the largest whale that I have heard of in these Parts, yielded one hundred and ten barrils of Oyl, and twelve hundred Weight of bone." [2]

Paul Dudley, in his essay on the whales of New England, records that "one of these Whales has yielded One hundred and thirty Barrels of Oil, and near twenty out of the Tongue."

Collett states that four whales of this species yielded a ton of whalebone worth (in 1909) about $7500, and that the weight of baleen in a full grown specimen is from 250 to 330 kilograms (551 to 668 pounds).

The Right Whale usually floats, nearly awash, when dead, so that it is not so difficult a matter to tow it ashore when captured at sea. This, however, is not always the case, depending doubtless on the condition of the whale, whether there is less than the normal amount of blubber in proportion to the flesh and bone to decrease the specific gravity of its body to less than that of sea water. A "thirty-barrel" Right Whale (and hence comparatively lean for this species) was struck off Nantucket in April, 1886, and after a short struggle, was dispatched. It was no sooner dead, however, when it "rolled over and sank in eleven fathoms of water" so

[1] Douglass, W. A. A Summary, historical and political, of the first planting, progressive improvement, and present state of the British settlements in North America, 1755, vol. 1, p. 56.

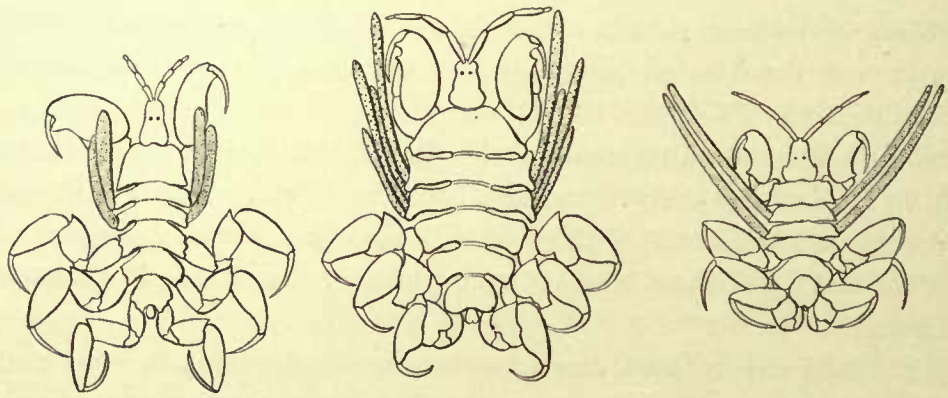
[2] Documents relative to Colonial Hist. N. Y., 1855, vol. 5, p. 60.

that it was necessary to attach a buoy to the line and wait for the body to rise, "which it was thought it would do in about forty-eight hours" (Nantucket Journal, vol. 8, no. 30, Apl. 22, 1886).

The use of whalebone for stays in women's clothes probably dates back to the early days of whaling, perhaps the 10th century or thereabouts. Blackstone mentions the ancient right of the Crown to a share in the oil and baleen of the whales taken. He says: "Another ancient prerequisite belonging to the Queen Consort, mentioned by all old writers,. . . .is this; that on the taking of a whale on the coast, which is a royal fish, it shall be divided between the King and Queen, the head only being the King's portion, and the tail of it the Queen's. The reason of this whimsical division, as assigned by our ancient records, was to furnish the Queen's wardrobe with whalebone." [1] Pennant explains that it was anciently believed that the plates of baleen were the tail of the monster, hence the whalebone must have been allotted the Queen.

Enemies and Parasites.

The Orca or Killer Whale (*Orcinus orca*) is said occasionally to attack the Right Whale; sometimes several combine and appear to be trying to bite the lips and tongue. These accounts require confirmation, however. Otherwise, the species is not known to have any natural



2 3 4

TEXT-FIGS. 2, 3, 4.— Three species of Whale-lice, small crustaceans parasitic on the Right Whale.
2.— *Cyamus gracilis* ♂. After Lutken, 1873, Plate 4, fig. 10.
3.— *Cyamus ovalis* ♂. After Lutken, 1873, Plate 2, fig. 4.
4.— *Cyamus erraticus* ♂. After Lutken, 1873, Plate 3, fig. 5.

enemies, a fact which may in some measure account for its quiet habits. It is not even known that individuals fight among themselves, and its powerful tail is its only means of defense.

Of ectoparasites, the so-called Whale-louse is the best known. This is an amphipod crustacean that has become highly modified for its peculiar mode of life. The body is about half

[1] Blackstone's Com. Book, vol. 1, p. 222.

an inch in length, much flattened, with five pairs of legs, each armed with a sharp recurved claw for clinging to the whale. There are two pairs of anterior clawed appendages and three posterior. On the intermediate two segments are the paired branchial sacs. The abdomen has become reduced to a mere knob. Lütken (1873) found two species on the Nordkapers taken at Iceland: *Cyamus ovalis* and *C. erraticus*. Guldberg (1891) in examining two other specimens of this whale at Iceland, found *C. ovalis* only, and this is probably the common species in the North Atlantic. In the Southern Ocean, a third species, *C. gracilis*, is found together with the two others, infesting the Southern Right Whale. In the North Pacific, *C. ovalis* and *C. gracilis* also occur together, and the latter may be looked for perhaps in the North Atlantic. These crustaceans infest the rugosities on the rostrum, and on the anterior ends and sides of the jaw, and may also be found about the genitalia or scattered over the body. It is not unlikely that they cause the rough appearance of the knobs on the head, but there is no reason to suppose that the 'bonnet' is the result of inflammation induced by their activity as one writer has suggested. A number were observed on the Provincetown 1909 whale, but unfortunately none was preserved. The genus is omitted from Miss Rathbun's list of New England Crustacea.

Apparently the North Atlantic Right Whale does not usually carry barnacles. Indeed the only definite mention of these crustaceans on our species is the statement of Van Beneden (1890) that he possessed an excellent drawing of a Coronula made from a specimen taken from the skin of a Nordkaper captured toward the end of the 18th century between Iceland and Newfoundland. The evidence of its origin does not seem to be quite as convincing as one could wish, and in view of the apparent lack of other records of its occurrence on this whale, there is a strong presumption that it may have come from a Humpback. In the same paper, Van Beneden (1890) figures a Coronula, identified as *C. reginæ*, a Pacific species, which was picked up on the Gaspé shore, Gulf of St. Lawrence, attached to a piece of the integument of a whale. He believes this may have come from a North Atlantic Right Whale, and adduces this specimen as evidence of the world-wide range of the species. The evidence, however, is inconclusive. The specimen is of unknown origin, and may even have been taken in the Pacific, kept by some whaleman, and thrown overboard in the Atlantic and so drifted to the Gaspé coast.

On the Right Whale of the South Seas, however, a cylindrical species, *Tubicinella trachealis*, occurs imbedded deep in the bonnet. According to Steenstrup (Lütken, 1873, p. 244) a specimen supposed to have come from a Nordkaper stranded on the Färoe Islands in 1650 is figured and described by Ole Worms.

Jonah and the Whale.

A question very frequently asked is: What kind of whale was it that swallowed Jonah? If a whale actually did swallow the prophet, it was certainly none of the whalebone whales. For in all these the gullet is far too small to permit of such a feat, and even in the larger species is not greatly bigger than the diameter of a large man's fist. The Sperm Whale is probably the only one of the existing whales that is capable of swallowing a man, but that it would actually do so is very unlikely.

According to the biblical account, Jonah had been called by the Lord to go to Nineveh to preach to the people of their wickedness. But he, fearing to do so, embarked at Joppa on a ship for Spain (Tarshish) and on the voyage was caught in a heavy storm. The ship's crew believing Jonah to be the cause of the storm, at his bidding cast him into the sea. The translation of the Hebrew text reads (Jonah i: 17): "Now the Lord had prepared a great fish to swallow up Jonah. And Jonah was in the belly of the fish three days and three nights." There is thus nothing to show that a *whale* was intended. That it was a whale, however, is supposed to be indicated by the passage in Matthew's Gospel (xii: 40): "For as Jonas was three days and three nights in the whale's belly; so shall the Son of man be three days and three nights in the heart of the earth." But the word translated as 'whale' is the Greek κῆτος which means a sea monster and might quite as well have been a shark or other large marine animal. For those who prefer a literal interpretation of the passage, therefore, the "great fish" may have been a huge shark or even a Sperm Whale, while those who wish to take it figuratively, may dodge the issue by supposing Jonah to have been cast off in a small boat which he likened to the bowels of a sea monster, but which after three days of rough weather eventually brought him to land. Haupt (1907) adduces several instances of the occurrence of the Sperm Whale in the Mediterranean, and suggests that the idea of a sea monster was given to the author of the Book of Jonah by the local legends connected with Joppa, the port from which Jonah embarked; for it was here that Andromeda was rescued from a sea monster by Perseus.

What a pity, as someone has remarked, that so great a prophet should be chiefly remembered for this trifling incident of his missionary journey!

An Indian Totem.

An interesting carved stone, apparently a piece of aboriginal art, has been described from Seabrook, N. H., by Professor F. W. Putnam.[1] It evidently represents a cetacean, with rudely indicated pectoral fins and horizontal tail. The absence of a dorsal fin might indicate that it was meant to represent the Right Whale, but the mouth has more the form of a White

[1] Putnam, F. W. Bull. Essex Inst., 1873, vol. 5, p. 111, figs.

Whale's (Delphinapterus). The probability seems to favor its having been a Right Whale, however, since this species must have been of importance and well known to the Indians, whereas the White Porpoise is rare on our coast. The carving is described as rudely done by picking the sienitic rock, from which it was made, with stone implements. A small hole through the tail seems to imply that it was to be suspended. It measured ten inches in length and about two inches in greatest diameter. Professor Putnam believed that it was probably used by the Indians as a totem. Two other similarly worked stones were said to have been found at the same place.

A somewhat similar stone is in the museum of the Department of Archaeology, of Phillips Academy, Andover, Mass. It was found at Fall River, and differs from the Seabrook specimen in the greater crudeness of design. The flukes are not shown, but instead the tail end is tapering, with a groove as if for suspension by a cord. Possibly both were used as plummets or sinkers for fish nets.

Balaenoptera physalus (Linné).

Common Finback Whale.

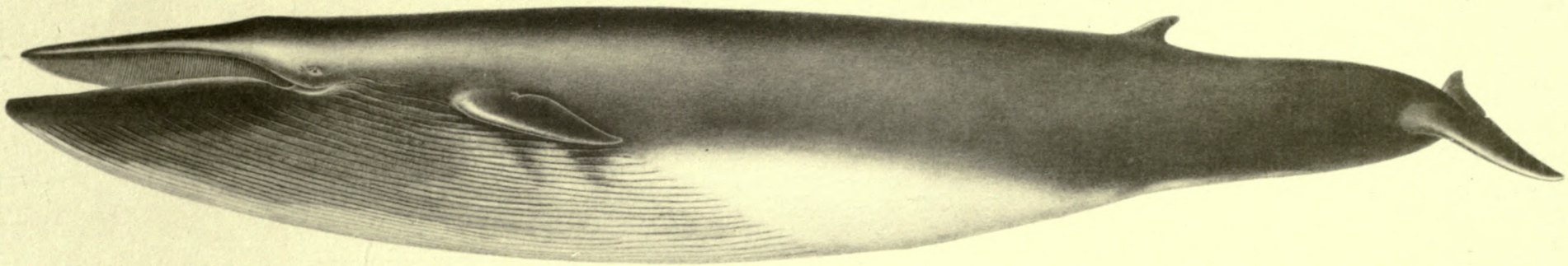
Plate 10; Plate 11, fig. 2; Plate 13, figs. 4, 5.

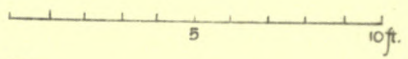
Synonymy.

1758. *Balaena physalus* Linné, Syst. Nat., ed. 10, vol. 1, p. 75.
1758. *Balaena boops* Linné, Syst. Nat., ed. 10, vol. 1, p. 76 (= young of *B. physalus*).
1792. *Balaena physalis* Kerr, Anim. Kingdom, vol. 1, p. 358.
1803–4. *Balaenoptera gibbar* Lacépède, Hist. Nat. des Cétacés, vol. 1, pp. liii, 168, pl. 1, fig. 2.
1803–4. *Balaenoptera rorqual* Lacépède, Hist. Nat. des Cétacés, vol. 1, pp. liv, 185, pl. 1, fig. 3; pl. 5, fig. 1; pl. 7.
1811. *Balaena sulcata* Neill, Mem. Wernerian Soc. Nat. Hist., vol. 1, p. 212.
1820. *Balaena gibbar* Desmarest, Mammalogie, vol. 1, p. 528.
1825. *Balaenoptera sulcata* Jacob, Dublin Philos. Journ., p. 333.
1827. *Balaena rostrata* var. *major* Rosenthal, Einige naturhist. Bemerk. über die Walle, plate.
1828. *Balaenoptera mediterrancensis* Lesson, Hist. Nat. Gén. et Partic. des Mamm. et des Oiseaux, Cétacés, pp. 361, 442 (renaming of Lacépède's *B. rorqual*).
1828. *Physalis vulgaris* Fleming, Hist. British Animals, p. 32.
1829. *Balaena antiquorum* Fischer, Synopsis Mamm., p. 525.
1829. *Balaenoptera aragous* Farines and Carcassonne, Mémoire sur un Cétacé échoué le 27 novembre 1828 sur la côte....de Saint-Cyprien. Perpignan, 2 pages.
1830. *Balaena musculus* Companyo, Mémoire descriptif et ostéographie de la baleine échouée sur les côtes de la mer, près de Saint Cyprien, département des Pyrénées-Orientales, le 27 novbre 1828. Perpignan, 71 pp., 5 pls.
1834. *Balaenoptera jubartes* Dewhurst, Nat. Hist. Cetacea, p. 101 (not Lacépède).
1836. *Rorqualus musculus* F. Cuvier, Hist. Nat. des Cétacés, p. 334.
1837. *Balaenoptera borealis* Rapp, Die Cetaceen zoologisch-anatomisch dargestellt. Stuttgart und Tubingen, 8vo, p. 52, (not of Lesson).
1840. *Balaenoptera tenuirostris* Sweeting, Charlesworth's Mag. Nat. Hist., new ser., vol. 4, p. 343.
1841. *Balaena sulcata arctica* Schlegel, Abhandl. Zool. u. Vergl. Anat., no. 1, pl. 6, figs. 1, 2.
1843. *Balaenoptera arctica* Schlegel, Weit. Beitr. z. Naturg. Cetaceen, p. 10, pl. 9.
1846. *Balaenoptera antiquorum* Gray, Zool. Voyage Erebus and Terror, Mammalia, p. 50.
1847. *Physalus antiquorum* Gray, Proc. Zool. Soc. London, p. 90.
1847. *Physalus* (*Rorqualus*) *boops* Gray, Proc. Zool. Soc. London, p. 91.
1856. *Physalus duguidii* Heddle, Proc. Zool. Soc. London, p. 187–198, pls. (Mamm.) 44, 45 (name occurs on plates only).
1857. *Pterobalaena communis* van Beneden, Bull. Acad. Roy. Belg., Bruxelles, ser. 2, vol. 1, p. 403.
1860. *Balaenoptera robusta* Lilljeborg, Föredrag vid Naturforsk-Mötet i Köpenhaun, p. 602; Upsala Univ. Arsskriv., 1862 (not *Eschrichtius robustus* of Gray; based on a subfossil and imperfect skeleton from Sweden).
1862. *Pterobalaena musculus* Lilljeborg, Upsala Univ. Arsskrift for 1861–2, p. 43.
1862. *Balaenoptera physalus* Schlegel, De Dieren van Nederland: Gewervelde Dieren, p. 101, pl. 20; True, Proc. U. S. Nat. Mus., 1898, vol. 21, p. 633.

PLATE 10.

Common Finback Whale (*Balaenoptera physalus*). Drawn by J. Henry Blake from measurements of Dr. Dwight's Gloucester, Mass., specimen (see Memoirs B. S. N. H., 1872, vol. 2, p. 203).





COMMON FINBACK WHALE.

HELIOTYPE CO., BOSTON

1863. *?Balaenoptera syncondylus* A. Müller, Schrift. K. Phys. Ockonom. Ges. Königsberg, vol. 4, p. 38–78, pl. 1–3.
1864. *Rorqualus antiquorum* Gervais, Compt. Rend. Acad. Sci. Paris, vol. 59, p. 880.
1864. *Benedenia knoxii* Gray, Proc. Zool. Soc. London, p. 212, fig. 8–8b.
1869. *Sibbaldius tuberosus* Cope, Proc. Acad. Nat. Sci., Phila., p. 17 (=*B. physalus*, fide True, 1904).
1869. *Sibbaldius tectirostris* Cope, Proc. Acad. Nat. Sci., Phila., p. 17.
1871. *Benedenia boops* Gray, Supplement to Cat. Seals and Whales British Museum, p. 52 (not Gray, Synopsis, 1865, as here stated).
1871. *Physalus musculus* Malm, Kongl. Svenska Vet.-Akad. Handl., vol. 9, pt. 2, no. 2, p. 40.
1873. *Physalus dugeridii* Gray, Zoologist, ser. 2, p. 3363 (misprint).
1884. *Dubertus rhodinsulensis* Trumbull, in G. B. Goode, Fisheries and Fishery Industries of U. S., section 1, vol. 1, p. 29 (*nomen nudum*).
1914. *Balaenoptera muscularis* Daniel and Hamilton, Rept. 83d Meeting British Assn. Adv. Sci., 1913, p. 155 (*errorim*).

History and Nomenclature.

Although the Finback had long been known in a general way, and is probably the species referred to by Pliny as known to the Ancients, it was perhaps not until 1675 that it was recognizably described and figured by Martens in his Spitzbergische oder Grönlandische Reise Beschreibung gethan im Jahr 1671, where it is called "Finfisch." In 1725 Paul Dudley, in his essay on the natural history of the whales of New England, also distinguished this species carefully, and it is on these two accounts that the Latin names of the earlier systematists, Klein, Brisson, and Linné, were chiefly based. True (1898) has carefully analysed Linné's references in the tenth edition of the Systema Naturae and has shown conclusively that his *Balaena physalus* is the Common Finback, since it is based on Martens's account. Linné's *Balaena boops*, he further proves, was founded on Sibbald's account (published in Phalainologia Nova, 1692) of a young whale of the same species, hence it becomes a synonym of *physalus*, and is not applicable to the Humpback, notwithstanding current usage to the contrary till very recent years.

In his Histoire Naturelle des Cétacés, 1803–4, the French naturalist Lacépède erected the genus Balaenoptera for the Finner Whales, and through a misconception, named as *B. gibbar* a supposed species without throat folds. This, however, was undoubtedly based on an imperfect figure by Martens, 1675, in which no throat folds were shown. The name *Balaenoptera rorqual* was given in the same work to what was considered the real Finback. In 1811 Neill redescribed the Finback from a specimen from Scottish waters under the name of *Balaena sulcata*, in reference to the longitudinal throat folds, and in 1841, Schlegel, in an anatomical paper on the same species used this name in a trinomial, *Balaena sulcata arctica*. In a separately published work by Rosenthal, 1827, is a very circumstantial account of the capture of a whale on the west coast of Rügen, Germany, two years before. It is accompanied by a plate, drawn to scale, showing a Balaenoptera some 43 feet long with white

belly and high dorsal fin. The name *Balaena rostrata* var. *major* is given it, and its skeleton appears to have been preserved at Greifswald. Eschricht (1899) refers to the specimen, and from the fact that he credits it with fifteen pairs of ribs, it was probably a Finback. The British naturalist Fleming, in 1828, proposed to call the Common Finback *Physalis vulgaris*, though his account probably relates to the Blue Whale as well, while in the same year the French naturalist Lesson gave the name *Balaenoptera mediterraneensis* to the Finback of the Mediterranean Sea, founding his account on Lacépède's description of a specimen from the coast of Southern France. Fischer the following year, 1829, independently named the Mediterranean Whale supposing it to be different from that of the Atlantic. His name, *Balaena antiquorum*, is based chiefly on Lacépède's description, but he refers also to the accounts of Pliny and the older naturalists. This same year, 1829, a Finback Whale was cast ashore on the French coast at Saint Cyprien and formed the subject of a brief communication by MM. Farines and Carcassonne, who called it *Balaenoptera aragous* after M. Arago, one of the chief men of the Département where the whale came ashore. This name is quoted by Gervais (1864), but does not seem to appear elsewhere in literature. The following year, 1830, Companyo published a more extended account of this same specimen, which he called, unfortunately, *Balaena musculus* of Linné, referring it to the subgenus Balaenoptera. In the application of this specific name to the Finback Whale, most later writers have followed him until True (1898) showed that Linné's *musculus* refers to the Blue Whale. Thus, previous to 1831, no less than eleven different trivial names were proposed for the Common Finback of the North Atlantic.

Schlegel, in 1862, was the first to employ the combination *Balaenoptera physalus*, which, as it now appears, is the correct term for our Common Finback. Meanwhile Sweeting in 1840 had described as *Balaenoptera tenuirostris* a specimen stranded at Charmouth Beach, England, and in 1856 a Finback captured in Orkney was named *Physalus duguidii* by Heddle. Van Beneden, in 1857, raised to generic rank the subgenus Pterobalaena, proposed in 1849 by Eschricht, and as the custom was, gave a new specific name at the same time — *Pterobalaena communis*.

The synonymy of this species furnishes a good index of the progress of cetology during the last century. The lack of knowledge as to the amount of individual variation in these great mammals, and the difficulty of making exact comparisons, led for a time to the belief that there were divers sorts characterized by various differences in form and skeleton which Gray, Eschricht, Lilljeborg, Cope and others proposed to consider as distinct species or even genera. Thus were founded such genera as Pterobalaena, Sibbaldius, Benedenia, with sundry species, as *Pterobalaena communis*, *Physalus duguidii*, *Benedenia knoxii*, as well as *Sibbaldius tuberosus* and *S. tectirostris* based on American specimens by Cope. But with the advance of knowledge, it has become apparent that the small or fancied differences which these names were intended to mark, are after all mainly matters of individuality or misconception, and that they all refer to but a single species.

Fossil remains, now considered indistinguishable from *B. physalus*, have been found in Sweden, and formed in 1860 the basis of Lilljeborg's *Balaenoptera robusta*. The posterior portion of a cranium dug up in Germany, and in which the condyles are unusually close together, may also be a Finback. It was made in 1863, the basis of Müller's *Balaenoptera syncondylus*. Fossil remains are known from the Pleistocene deposits of Canada.

The type locality given by Linné is the indefinite one of "Oceano Europaeo," but as his name is based on Martens's account, this should be interpreted as the seas between Europe and Spitzbergen.

The Greek derivation of the scientific name is from φάλαινα, a whale (which in Latin becomes *balaena*) and πτερόν, a wing or fin in reference to the dorsal fin. The specific term *physalus* — from φύσαλος, meaning a blow-fish, a species that has the power of distending itself with air — seems to refer to the blowing or spouting of the whale, as from a pair of bellows (φῦσα).

Vernacular Names.

All the whales of this genus have an adipose fin of varying size on the after part of the back, hence are spoken of collectively as the Finback or Finner Whales. In the present species, however, this fin is largest of all, high and falcate, affording a fairly characteristic field mark. On account of its general distribution and abundance, this whale fairly merits the name Common Finback Whale bestowed upon it. Among seamen it is also spoken of as the Razorback or the Pike Whale, in allusion to the high dorsal fin, or 'pike' as it is called by the fisherfolk of the English coast because of its fancied resemblance to that ancient weapon. Another term sometimes used by the English fishermen is Sprat Whale, for at certain times of the year it is found following the shoals of sprat or herring. The Scandinavian word 'rorqual' (from *rohr*, a tube, and *hval*, whale, in reference to the folds or plaits on the throat) has been adopted into our tongue for the Finbacks, and was even latinized to make the generic term Rorqualus by Frederic Cuvier. Hence the term Common Rorqual is sometimes used for this species. Among the earlier writers the Finback was often referred to as the Jubartes, or Dubertus, which was further shortened to Gibbar, Jubart, or corrupted to Jupiter-fish. The origin of these names is perhaps from the Latin *jubatus* meaning 'fringed with long hair,' a term therefore, descriptive of the long hanging bristles of the whalebone plates. Another and equally probable supposition is that the word comes from the provincial name Gibbar of the Biscayne fishermen, which is in Latin *gibbero dorso* (with a hump on the back). At the present time these names seem to have dropped out of use.

In other languages the name commonly applied to this whale is an equivalent of Finback or Finwhale thus Finnfisch or Finwal in German. The bristles or hair-like fringes of the whalebone plates, through their fancied resemblance to a hanging beard, have also given

rise to the name Bartenwalen (Bardehvalen in Norwegian) or Bearded Whales as applied by German and Scandinavian writers to the Finbacks.

Description.

Form.— In striking contrast to the Right Whale and the Humpback, the Fin Whales are of elongate and graceful shape — "clipper-built." This species, in particular, is of exceedingly beautiful lines, the head elongated and narrower in proportion to its width than in the others of the genus, the body long and evenly tapering with a high falcate fin on the back nearly over the anus, the peduncle or 'small' contracting towards the flukes with an elegant curve in both dorsal and ventral outlines. The great lower jaw bows outward so as to receive the narrowing upper jaw within its wall-like lips, and protrudes considerably beyond the tip of the snout. The pectorals or flippers are not especially elongated, in fact, are comparatively short, about 11 to 13 percent of the total length, rather narrow and pointed with the anterior margin and distal part of the posterior margin much straighter than in the Blue Whale. The flukes are distinctly and deeply notched at the middle of the posterior border; their anterior edge is gently convex, the posterior slightly concave below the tips, then swelling to a gentle convexity in the middle. The total breadth across the flukes is about one fifth the entire length.

The *eye* is described by True as having a brown iris with a narrow and irregular white border. The pupil is elliptical and with its long axis horizontal.

The *ear opening* is directly on the surface some thirty inches behind the eye and very slightly below it. It is oblong or nearly round and of a size large enough to admit with difficulty the "point of the little finger" (Struthers). The opening narrows, and at a distance of four or five inches from the exterior is "not larger than a crow quill."

Plicae.— The throat is marked by numerous longitudinal folds or plicae, like a series of ridges and valleys, which permit of considerable extension and by means of a superficial layer of muscular tissue may be brought together again. The purpose of this adaptation is not wholly clear. Possibly it allows a greater extension of the lungs, or more probably, it permits a great quantity of water to be engulfed, from which the small animals constituting the food, are strained out by the whalebone sieve, on closing the jaws. Still a third supposition is that by contraction of these folds, the whale is able to decrease its bulk and sink more easily in diving. The number of the plicae varies greatly, but in a line between the pectoral flippers, averages about seventy with extremes fifty-six and eighty as recorded by True in seven Newfoundland individuals. Not only do they run longitudinally from the lower part of the lips back nearly to the navel, but they often bifurcate, coalesce, or send off side branchlets, binding the entire system together. Posteriorly many of the plicae unite again so that the number is reduced here. There are also a few short furrows between the corner of the mouth

and the pectoral fin and above and below the root of the latter. The breadth of the abdominal ridges is about two inches near the middle of their length, and twice that posteriorly.

Color.— As seen in life at close range, the general color of the Finback above, is dull grayish brown (sepia, as the artist Millais says, passing into brownish gray on the flanks). This rapidly darkens after death, and becomes quite black after a short exposure, a fact which has led to some misconception as to the true color. The lower surfaces of the body, including the ventral side of the pectorals and flukes, and also the *right* mandible and more or less of the *right-hand* side of the upper lip, are white. The line of demarcation between the dark of the upper side and the white of the belly, though fairly well defined, is most irregular, and the one passes gradually into the other at the sides. On the left-hand side of the body, the dark color commences usually at or just back from the point of the jaws, and extends part way, often nearly to the midline, including the summits as well as the troughs of the plicae laterally, but the troughs alone more ventrally, while in the mid-region of the lower side these furrows too are white. Just in advance of the pectoral there is usually a darker tongue or two of color passing ventrally, where both ridge and trough of the plicae are pigmented over a narrow area. A somewhat similar tongue of dark color may be present behind the pectoral, invading the whitish of the sides. There may also be irregular dark blotches like islands on the sides of the throat, and usually one just behind the anus.

Usually a light marking, ill defined, from the region of the ear opening of the right side, "curves strongly upward, then downward, and terminates at or above the anterior insertion of the pectoral fin. On the left side another light line usually starts at the eye, and may run under or through rather than over the ear, and terminate at the insertion of the pectoral" (True, 1904, p. 124).

Most remarkable is what appears to be a definite and constant asymmetry, in that the *right* mandible, and commonly the tip of the *right* side of the snout are white. Even the whalebone plates at the anterior end of the right side are likewise white. It should be added that the white of the lower surface of the pectorals may extend around to their front edge or tip, but that on the flukes the white does not quite reach the margin ventrally.

Variations.— A number of specimens are described in detail by True (1904, p. 121) to show the individual variation in color pattern. Some seem paler than others, due to the varying degree to which the gray areas encroach on the belly and throat, or the presence of streaks and patches of darker color about the anus or the median line of the peduncle. The white of the right side of the head may include the entire lip from the tip of the snout to the angle of the mouth, or it may be confined to the anterior third or fourth. The post-anal gray mark, may in some cases be nearly obsolete. In one instance the white of the right side of the head was so extensive as to exclude all gray color from the ridges in front of the pectoral. On the left side, the mandible is usually dark nearly to its tip but the white may extend to about the

fourth furrow of that side. In one individual only there was an irregular pure white blotch on the *right* side of the dorsal fin near its tip. True noted in some individuals a darker gray band passing from above the eye upward and backward on to the shoulder. "There is commonly a light gray, or whitish, mark under the eye, especially on the right side, and sometimes a similar mark around the right ear."

In occasional specimens the brownish gray of the flanks extends on to the under surface, giving it a darker cast, instead of the clear white of the normal coloration. Such individuals are supposed by the whalemen to be hybrids between this species and the Blue Whale, and hence are called Bastard Whales. But there is no reason to suppose that the two species hybridize, or that these peculiar individuals are more than variations from the normal pattern.

Hair.— The Cetacea have lost all trace of a hairy covering on their bodies, but on certain parts of the head a few hairs still persist, as remnants of what we may suppose was in past ages, a scanty supply, similar perhaps to that of the modern elephants. In the toothed whales, the hairs are no longer found in adults, though young or foetal specimens may show a few in definite spots. Among the whalebone whales, however, a considerable number is retained throughout life. These are restricted to definite parts of the outer surfaces of the jaws, and correspond roughly to the vibrissae or 'feelers' of certain other mammals. They are most numerous in the Right Whales and in the Humpback, but in the Balaenopterae are fewer in number and with a much more definite distribution. The Common Finback possesses two series of these short grayish bristles on each side of the upper jaw. The outer row begins about over the angle of the mouth, and runs to the tip of the snout. It consists of a series of some eight single bristles set at fairly regular intervals parallel with the outer rim of the rostrum and a short distance in from that edge. The second row is nearly parallel to this, of eight or nine bristles, but is closer to the median line. It commences back of the blowholes and passes anteriorly along the median ridge of the snout, to a point some distance behind the tip. On each side of the lower jaws are two other series of short whitish bristles. One consists of some nine in all, set at considerable intervals along the middle of the outer edge of the ramus to a point just in front of the eye. The other is a short *vertical* row at the tip of the jaw on each side, made up of about fourteen hairs, rather close together (Lillie, 1910).

A recent investigator (Japha, 1911) has made a microscopic study of these hairs. He finds that their structure is much like that of the ordinary mammalian hair, except that the sebaceous glands are lacking. They have a well developed bulbus, supplied with blood vessels, and, what is of great interest, nerve endings. This latter fact indicates that the hairs are sensory and as had been previously suggested, are probably tactile organs, whose function may be to indicate the presence of the minute crustaceans or small fishes on which these whales feed.

Baleen.— The baleen or whalebone plates are about 430 in number counting along the

external side of the mouth, where they are longest. Toward the median line of the palate, however, there are some four ranks of smaller, narrower plates so that the whole series forms a gradual slope decreasing from the exterior to the median line of the mouth. The lingual side of these triangular plates is fringed with long bristles that form a matted and tangled mass, whereby the minute crustaceans on which the whale feeds, are strained out as by a sieve, from the water taken into the mouth. Delage, who made a careful study of the arrangement of the baleen plates, found the external row to consist of some 430 plates, then passing toward the center of the mouth, came two ranks of shorter and smaller plates, each of about the same number as the first. Then followed a fourth rank, consisting of twice as many plates and finally a fifth rank, whose plates are smallest of all in size but from four to six times as numerous as those of the first.

The color of the plates and of their bristles is characteristic. The plates themselves are generally particolored or streaked vertically. At their outer edge they are dark gray, or purplish, varied internally with streaks of white, but toward the posterior end of the series are more uniformly dark gray. On the *right-hand* side, a large number of the anterior plates are white, or white externally and more or less streaked with gray internally. As many as half the total number of plates on the right side may be white, producing thus an extraordinary asymmetry in color, for the plates of the left-hand side are dark throughout externally. The coarse bristle-like fringe, as seen when looking into the mouth, is a dull white or yellowish white mass, more or less curly and tangled. The longest blades of whalebone, exclusive of the bristles, measure usually from 20 to 24 inches; the latter dimension is unusual, however, and is given by True (1904) for a very large specimen of 70 feet 8 inches, killed at Newfoundland.

External Measurements.— The total length of an adult Common Finback is usually about 60 to 65 feet, and though Cocks has recorded one as long as 80 feet, it is not clear that he personally measured it or that the measurement was in a straight line from snout to caudal notch. True (1904) has tabulated the lengths of twenty-five specimens measured by him at Newfoundland. Of these the largest male was 65 feet long (19.81 meters), the largest female 70 feet 8 inches (21.54 meters). The smallest of fifteen females found containing a foetus (and so sexually mature) was 61 feet 10 inches (18.85 meters). Cocks, however, records a female of 55 feet 7 inches (16.94 meters) containing a foetus, and Millais a fifty-foot female also with a foetus. This last is probably near the minimum size of an adult. The data at hand do not warrant the assumption that the females grow to a larger size than the males, though observations at the Newfoundland and Norwegian stations show from two to four feet greater average length for the females captured.

The only available measurements of this whale based on a New England example are those given by Dr. Thomas Dwight in volume 2 of the Society's Memoirs. These are incomplete, however, and in the following table I have given in addition to these the dimensions

of the largest male and female recorded by True (1904, p. 116) from Newfoundland, to which I have added the relative percent that each measurement bears to the total length.

External Measurements of the Common Finback.

	Gloucester, Mass. ♀				Newfoundland ♂				Newfoundland ♀			
	Ft.	In.	Meters	%	Ft.	In.	Meters	%	Ft.	In.	Meters	%
Total length, snout to notch of flukes	48	0	14.63	100	61	2	18.64	100	70	8	21.54	100
Tip of snout to eye	9	8	2.95	20.1	12	6.5	3.81	20.4	14	1	4.29	19.9
" " " " blowhole (center)		—			11	3	3.43	18.4	12	10	3.91	18.1
" " " " ant. insertion of pectoral	14	7	4.44	30.3								
" " " " post. insertion of pectoral		—			20	4	6.19	33.2	23	9	7.24	33.6
" " " " ant. base of dorsal fin	36	7	11.15	76.2	43	10	13.36	71.6	49	10	15.19	70.5
Notch of flukes to anus	14	3	4.34	29.6	17	0	5.18	27.7	20	2	6.15	28.5
" " " " clitoris	15	6	4.72	32.2		—			22	5	6.83	31.7
" " " " penis (center of orifice)		—			21	9	6.63	35.5		—		
" " " " navel	20	11	6.37	43.5	26	7	8.1	43.4	31	10	9.70	45.0
Length of pectoral from head of humerus	5	4	1.62	11.0	7	4	2.23	11.9	8	10	2.69	12.4
" " " " tip to post. insertion		—			5	0	1.52	8.1	6	0	1.83	8.4
Greatest breadth of pectoral	1	4	0.40	2.7	1	11	0.58	3.1	2	0	0.61	2.8
Height of dorsal fin	1	1.7	0.35	2.3	1	6.5	0.47	2.5	1	19	0.53	2.4
Length of base of dorsal fin	2	7	0.78	5.3	3	8	1.12	6.0	3	8	1.12	5.1
Center of eye to center of ear opening	2	3	0.68	4.6	3	1.5	0.95	5.0	3	4	1.02	4.7
Breadth across flukes		—			15	2	4.62	24.7	15	2	4.62	21.4
Length of blowholes	0	6	0.15	1.0								

Weight.— The specific gravity of a Fin Whale is slightly more than that of sea water so that when freshly killed it sinks, but the generation of gases due to decomposition eventually brings it to the surface. The weight of a 60-foot specimen, according to Murie (1865) was estimated at 45 tons. Guldberg (1907) has suggested a method for obtaining the approximate weight of a whale by means of a mathematical formula. The body is likened to a solid produced by placing two cones of equal diameter base to base, the height of the posterior cone twice that of the anterior. If the greatest diameter (D) ($\frac{1}{3}$ the circumference) and the total length, are known it is possible to obtain the volume of a cone by the formula ($V = \frac{1}{3} \frac{\pi}{4} D^2L$). This, if the specific gravity be assumed to be the same as that of water, gives also the weight. Guldberg averaged the lengths and girths of twenty-one Finbacks ranging between 51 and 68 feet long, and from these obtained a mean of 62.5 feet (19.45 meters) for the length and 29.6

feet (2.99 meters) for the greatest girth or the diameter. Applying these figures in the formula he obtained 45.8 tons or 45,800 kilo for the weight, which accords remarkably with Murie's figure for a 60-foot Finback. According to Wilcox, the 60-foot whales killed in the Gulf of Maine in 1885, weighed about 25 tons each, but it is not stated how this figure was obtained.

Auditory Apparatus.— An interesting recent account of the internal ear is given by Lillie (1910, p. 775) who dissected this organ in an adult Finback taken on the Irish coast. The auditory canal is continued backward from the minute external opening until it reaches the posterior border of the squamosal bone. It then turns inward, and with slightly increased diameter (1.5 inches) follows along the posterior edge of the squamosal to reach the tympanic membrane, which, curiously, is sac-like in shape somewhat like the finger of a glove. This sac is about four inches long; its blind end lies in the auditory canal, and its open end joins the wall of this canal, and by a ligament connects with the malleus, which is fused with the oval tympanic bone. The semicircular canals in the middle ear are present but small. The eustachian tube is about one foot in length and connects the cavity of the pterygoid fossa with the chamber at the junction of the nasal passages. There is a large plug of ear wax in the tube of the external auditory meatus. It is not certain that sound is received through the ear, though the tympanic bones may respond to vibrations through the water. Lillie suggests that the curious tympanic membrane, shaped like a glove-finger, may act as a pressure gauge, by coming in direct contact with water in the external ear passage, and thereby apprise the whale of its near approach to the surface when it rises to spout.

Musculature.— The muscular anatomy of the Finback Whale probably differs little in general from that of the Little Piked Whale as described by Carte and MacAlister (1868). Delage (1885) describes the large panniculus which covers all the anterior half of the lower portion of the body, beginning anteriorly on the arch of the jaws and extending back to the umbilicus. It thus corresponds roughly with the area of the external plicae. Superficially it is strongly united to the blubber, especially on the throat where it seems inserted into the skin, and by aponeurosis.

Struthers (1871, p. 111) seems to have been the first to make a careful dissection of the muscles of the hand. These are reduced to three on the inner or flexor aspect and a single one on the outer or extensor aspect of the hand. The latter corresponds to the *extensor communis digitorum*. It arises from the inner aspect of both radius and ulna and from the aponeurosis between them. It becomes tendinous, and opposite the middle of the carpus sends off four tendons, one to each digit. Of the three flexor muscles, the *flexor carpi ulnaris* has the usual relations, arising from the olecranon cartilage and ulna near it, and inserting by tendon into the pisiform cartilage. The *flexor digitorum ulnaris* is the largest of the muscles, arising along the center of the forearm, partly from the end of the humerus, ulna, and interosseous tissue. Its tendinous expansion finally gives off four branches one to each digit, but

that to digit I joins the tendon of the remaining flexor, *flexor digitorum radialis* (or *longus pollicis*) whose origin is along the proximal two thirds of the radius and the interosseous membrane. The presence of this muscle is in support of Kükenthal's contention that digit I is retained, and digit III is the missing one. The function of these muscles is doubtless to give stiffness to the paddle.

Visceral Anatomy.— An account of the anatomy of a male Finback stranded on the English coast, was published by Murie in 1865. It was an adult, 60 feet long, with the epiphyses of the bones fused. The oesophagus is described as 7 or 8 feet long, and of such a diameter that "the closed fist could be passed with ease through any part of its course." In Newfoundland specimens, True (1904, p. 128) found the width of the gullet to be about 7 inches. The stomach consists of four separate compartments, which communicate by round and somewhat constricted openings. The first division is large and rounded like a great bag, some 99 inches on the greater curvature; the second is more cylindrical, opening from the upper part of the first division, and is about 97 inches long. Its walls are slightly thicker and in both are plicated. The third and fourth divisions are shorter and cylindrical. Immediately below the last cavity of the stomach the hepatic duct enters. The total length of the small intestine of Murie's specimen was 248 feet or four times the length of the whale. The large intestine measured about 40 feet. There is no caecum.

A remarkable adaptation to aquatic life is found in the Cetacea whereby a projection of the epiglottis extends upward from the pharynx or throat as a tube into the posterior narial opening of the skull, so that a continuous passage is formed from the blowholes to the lungs, and thus effectually prevents the entrance of water into the lungs from the mouth. A similar structure occurs in the Ungulates, so that, as in the horse, they cannot breathe through the mouth. In the whalebone whales, this extension of the air tube is about in the center of the pharynx so that in swallowing, the small fish or minute crustaceans pass on either side. In the toothed whales, as Lillie (1910) has most suggestively shown, the larger size of the food particles has caused the displacement of the epiglottis to the left-hand side of the gullet, leaving a single large opening for the passage of food. The marked bilateral asymmetry of the skull in the Odontoceti, he believes is a result of this displacement.

Skeleton.— The skull of the Common Finback (Plate 11, fig. 2) differs conspicuously from that of the other species of the genus found on our coast, in its long and narrow rostrum, which tapers evenly to a relatively sharp snout. True has shown that the average breadth of the rostrum at the middle is barely a fifth of the total length of the skull. In museum specimens the drying of the bones often causes the tips of the maxillaries and intermaxillaries to spread apart, but the long and tapering outline of the former, especially as seen from below, is marked. Viewed from above the frontals appear somewhat trapezoidal in outline; the hinder margin forms nearly a right angle with the long axis of the skull, and the external margin

PLATE 11.

Outlines of the crania of New England whalebone whales, from above.

Fig. 1. North Atlantic Right Whale (*Eubalaena glacialis*). After the photograph by True (1904, Plate 42, fig. 1) of a Long Island, N. Y., specimen.

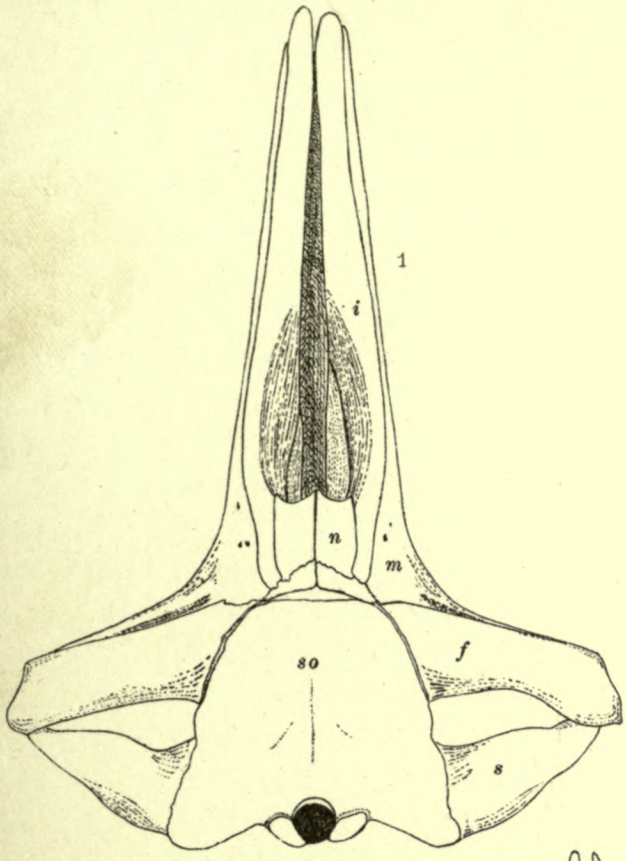
Fig. 2. Common Finback Whale (*Balaenoptera physalus*). After the photograph by True (1904, Plate 1, fig. 3) of a Cape Cod specimen in the U. S. National Museum, no. 16039.

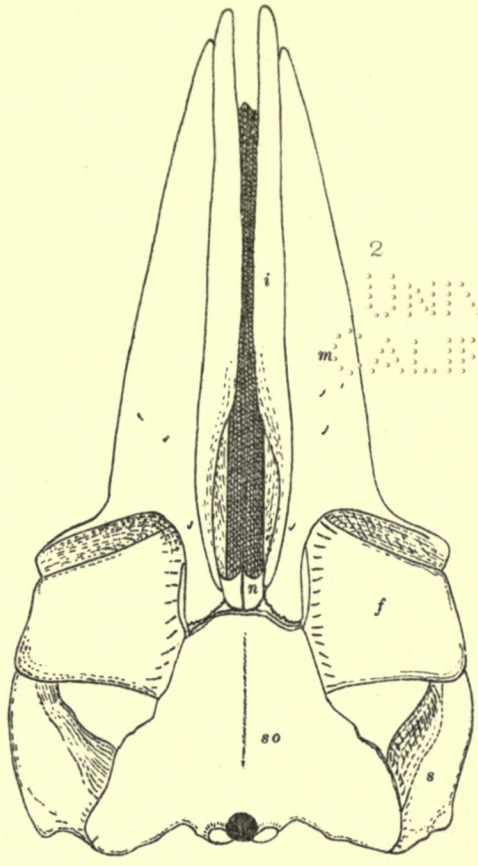
Fig. 3. Blue Whale (*Balaenoptera musculus*). After van Beneden and Gervais, Ostéographie des Cétacés, 1868–79, Plate 12–13, fig. 25.

Fig. 4. Little Piked Whale (*Balaenoptera acuto-rostrata*). After the photograph by True (1904, Plate 22, fig. 1) of a specimen from Harwichport, Mass., in the U. S. National Museum, no. 20931.

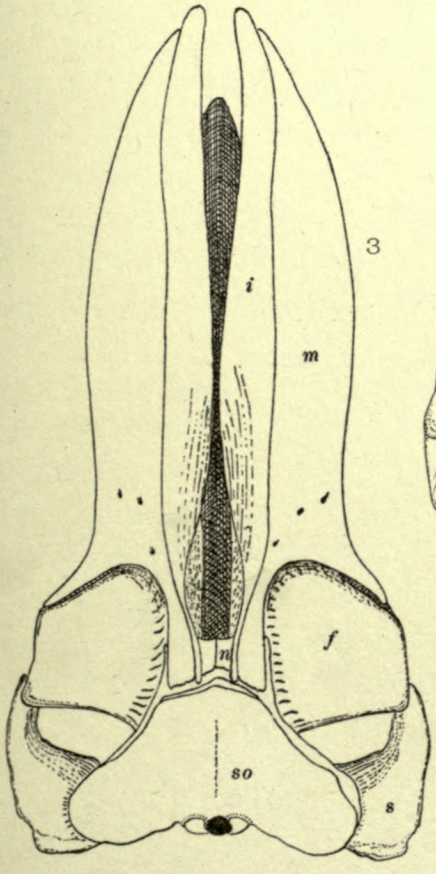
Fig. 5. Atlantic Humpback Whale (*Megaptera nodosa*). After the photograph by True (1904, Plate 29, fig. 2) of a specimen from Cape Cod in the U. S. National Museum, no. 21492.

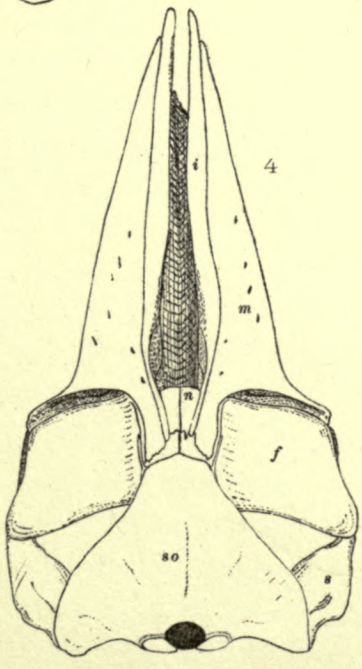
Abbreviations:—*f*, orbital process of frontal; *i*, intermaxillary; *m*, maxillary; *n*, nasal; *s*, squamosal; *so*, supraoccipital.

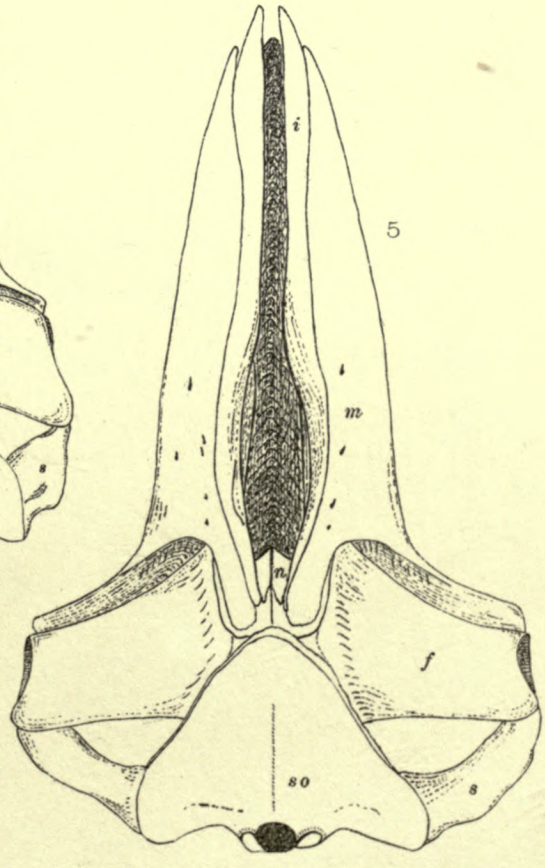




UNIV. OF CALIFORNIA







SKULLS OF NEW ENGLAND WHALEBONE WHALES.

UNIV. OF
CALIFORNIA

is at nearly a right angle to this. The front edge of this great bony plate slopes forward and inward forming an obtuse angle with the outer edge. The occipital bone is also somewhat characteristic. Its greatest length forms about 40 percent of the total length of the skull. At the vertex of the skull its sides are nearly parallel, or only slightly divergent, then spread laterally to form the posterior wall of the cranium. A well marked ridge is present in the middle line of the occipital. The shape of the nasals varies slightly, but as seen from above, they are usually deeply notched, and the median edges approximated to form a sharp point. A narrow prolongation of the intermaxillary reaches to about the middle of the nasals, and a larger process of the maxillary extends upward, expanding slightly, to abut against the vertex of the occipital. There is much individual variation in the shape and proportions of the various bones, and it is not yet clear how much of this is due to age. The lower jaw has a prominent coronoid process, which is lacking in the Right Whales.

In the following table of skull measurements those in the first and second columns are the dimensions (in English inches and mm. respectively) given by Dwight (1872) for the skull from Gloucester, Mass., in the Society's Museum, and in the third column these same dimensions expressed in percentages of the total length of the skull. The percentages in the fourth and fifth columns are those given in True's (1904) monograph for two specimens from Cape Cod in the U. S. National Museum. All three specimens are immature, and it is unfortunate that no measurements of a fully adult American specimen are available.

The percentages for the important measurements of these three skulls show a relatively close agreement, and indicate to some degree the range of individual variation.

The *hyoid bones* are large and somewhat inflated in outline. The form is rather characteristic in the genus. The basihyal is flattened and has usually a deep notch at its posterior end on either side of which articulates one of the stylohyals. Fused with the basihyal are the thyrohyals, which are flattened, and curve only slightly upward. The two sutures between these three component parts are usually indicated even in adult specimens. In the Society's specimen, the basihyal was 4.75 in the median line, while the distance between the tips of the thyrohyals in a straight line was 24.5 inches. The stylohyals were each about 15 inches long.

The total number of *vertebrae* in the Society's specimen is 63, which appears to be the maximum number yet recorded. Since unusual care was taken in the preservation of the small terminal bones, it is probable that this number is correct for the specimen. The formula is: 7 cervicals, 15 (or possibly 16) dorsals, 15 (or perhaps 14) lumbars, 26 caudals = 63. In the Society's skeleton the 15th pair of ribs is so long as to presuppose that there may have been an additional shorter pair of floating ribs, that became lost in the course of preparation. In this case the total number of dorsals would be 16, as in a skeleton from Newfoundland recorded by True. Skeletons with 14 and 15 rib-bearing vertebrae are usual.

Cranial Measurements of Common Finback.

	Gloucester Whale B. S. N. H.			Cape Cod	Cape Cod
	Inches	Millimeters	%	%	%
Length of skull (in a straight line)	144	3657	100.0	100.0	100.0
Breadth of condyles	11.75	298.4	8.1		
" " exoccipitals	44	1117.6	30.5		
Greatest breadth of skull (across squamosals)	67	1701.8	46.5	48.0	47.0
Length of supraoccipital (along curve, just avoiding median ridge)	29	736.6	20.1		
Length of orbital process of frontal (along lower surface from palatal)	27	685.8	18.7		
Breadth of orbital process of frontal at base	26	660.4	18.0		
" " " " " " at outer end	16	406.4	11.1	10.4	11.3
Length of nasals in median line	6	152.4	4.2	5.0	5.4
Combined breadth of nasals at base	3.75	95.2	2.6		
" " " " distally	9.5	241.3	6.6	5.2	4.9
Length of rostrum	100	2540	69.4	67.2	65.2
Breadth of maxillaries across orbital process (following curve)	71	1803.4	49.3		
Breadth of rostrum at base	50.5	1282.6	35.0		
" " " " middle	28	711.2	19.4	20	19.4
" " maxillary at same point	9	228.6	6.2		
" " premaxillary at same point	4.25	107.9	2.8		
Length of lower jaw in a straight line	137.5	3492.5	95.4	94.4	
Height at coronoid process	17.37	441.2	12.0		
" " middle	10	254	6.9	7.9	

True records three Cape Cod skeletons, of which two had 14 and the other 15 ribs, but it is possible that a terminal floating rib has been lost in some of these.

The cervical vertebrae are all separate from each other. The great atlas has a single large and bluntly tapering transverse process at the upper corner of each side, and its anterior face bears the two facets for articulation with the occipital condyles. These facets are slightly concave, somewhat elliptical with their long axes nearly vertical. The second to fifth cervicals have a long transverse process from the dorsal and one from the ventral corner of the centrum on each side. These two unite distally to enclose the large vertebrarterial canal, which varies much in its diameter but is usually completely ringed to the sixth vertebra. In this vertebra the ventral transverse process is but slightly developed, and no longer unites with the dorsal process. In the Humpback Whale, the transverse processes are much less developed so that the canal is usually open all its length. On the third and fourth cervicals, the transverse process slants strongly backward. A slight dorsal crest marks the median line of these vertebrae.

The dorsal vertebrae have high spines which culminate in size at the fore part of the trunk. The first four incline slightly forward, a few are then straight, and the remaining dorsal spines have a slight backward tendency. The transverse processes arise from nearly the whole length of the centrum; the anteriormost are from the upper part of the centrum, rather stout, and elliptical in section, ending bluntly with articular surfaces for the attachment of ribs. Passing posteriorly, these processes become more flattened and broader, widely expanded distally. At the same time they arise successively lower on the centrum till on the lumbars they are below the level of its middle.

The neural spine decreases in size on the lumbar and caudal vertebrae, and last appears on the 52d vertebra in the Society's specimen, and on the 50th and 51st respectively in two from Cape Cod (True, 1904). The last trace of the transverse process is on the 49th vertebra in the Gloucester skeleton and on the 48th in one from Cape Cod in the U. S. National Museum. The first perforated transverse process (diapophysis) is on the 45th and 43d vertebra respectively in these two skeletons.

In the mounted skeleton from Gloucester, the rapid tapering of the terminal vertebrae is rather striking. The last one of all is practically round, somewhat flattened from front to back, about 0.87 inches in diameter and 0.62 inches long. Measurements of the vertebrae are given in detail for this specimen by Dwight (1872, p. 214).

The *chevron bones* come one between each two caudal vertebrae, except the terminal three or so. They are roughly V-shaped, the first one small, the second much larger, and those following form a decreasing series. On account of the small size of the terminal ones, which are more or less cartilaginous in immature individuals, it is difficult without special care to be certain of the exact number. Hence it is that museum specimens are often incomplete in respect to these bones. There are but sixteen preserved in the Society's mounted skeleton from Gloucester. Van Beneden gives twenty-one as the number in a European specimen specially dissected by himself.

The *ribs*, as previously noted, are fifteen or sixteen in number. Probably sixteen is the normal series, with the last one of all a small floating rib, imbedded in the flesh and but loosely attached to the vertebra. Where fifteen are recorded, it seems likely that this small rib has been overlooked. A very interesting anomaly is occasionally found, in the shape of a two-headed first rib. This character was made by J. E. Gray the chief basis for his genera Sibbaldius and Hunterius, but Sir William Turner (1871) showed that, as in man, this bifurcated rib represents two fused ribs, of which the first is a cervical rib, articulating with the transverse process of the seventh or last neck vertebra, and the second is the normal first rib, articulating with the first dorsal vertebra. The articulating heads of such anomalous vertebrae lie at different angles to the main shaft of the rib. All the ribs are joined to their respective vertebrae by a single articulation at the end of the transverse process of the vertebra. This

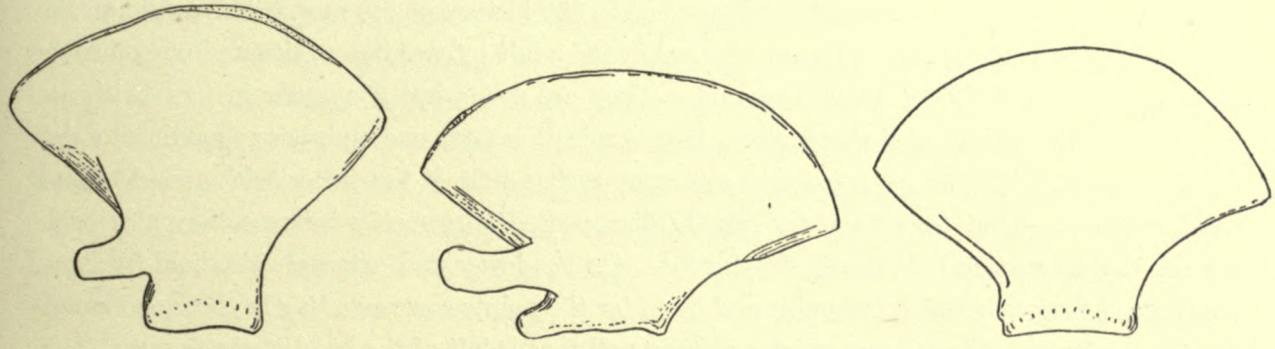
corresponds to the tubercular articulation of other mammals, for the second articulation by a stout rounded head between two neighboring segments of the spinal column is wholly lost. Vestiges of this head or capitular portion appear in some of the anteriormost vertebrae (the second and third in the Society's specimen) as short prolongations extending inward beyond the tubercular surface of attachment. A second noteworthy peculiarity of the ribs is that the first pair only are united to the sternum, and this union is ligamentous. The result of this loose attachment is that the thoracic basket formed by the ribs must be capable of more or less expansion, which is in correlation with the accordion-like plaiting of the throat. Possibly this serves as an aid in expanding the cavernous bag of the great mouth so as to engulf as large a quantity of water as may be, from which by closing the mouth and compressing the throat, the food is strained out by the baleen. Possibly, also, an increased lung capacity is obtained so that a longer stay under water may be made while the whale seeks its food. Yet, on the other hand, the Sperm Whale which dives deeper and stays down for longer periods shows no such adaptation, but has strong sternal ribs uniting the true ribs to the sternum.

In the Finback, the anterior ribs are broadest, but increase in length and become narrower and rounder in section. The sixth and seventh are the longest, and in the Society's specimen (immature) are respectively 75 and 74.25 inches in length along the curve.

The *sternum* is represented by the anterior segment only, the manubrium, for the segments which in most mammals follow this to form the breast bone, have quite disappeared in the baleen whales. The outline of this bone in immature individuals is a trefoil, with two broad anterior lobes and a narrow posterior part on either side of which come the first pair of ribs. A deep median notch separates the two anterior wings and indicates the original formation of the bone from two centers, one on each side. With age, the increasing ossification usually closes this notch, though often leaving a small hole in the middle of the bone, and the front end is developed into a median point, while at the same time the narrow posterior portion is slightly lengthened, producing a somewhat cruciform bone. There is considerable individual variation in the outline as well as variation due to age. Figures showing the form of this bone in a number of specimens, are published by True (1904, pp. 140, 141, figs. 8–31).

The *fore limb* is developed in all whales, and its skeleton consists of the scapula, arm, and hand bones as in other mammals, though these are much modified. The scapula is large, fan-shaped, longer than high, with a broadly convex dorsal outline. This outline is not an even curve, but is much flattened at the summit, and drops away suddenly at the posterior third. The spinous process is low and feebly developed, and differs remarkably from its usual condition among mammals in that it is very far forward, so as almost to coincide with the anterior edge of the scapula. The acromion process given off at its base is large and projects forward characteristically. The humerus is relatively very short and stout with large articular

surfaces. The radius and ulna are flattened and exceed the humerus in length. The elbow is well developed as a backward prolongation of the ulna extending up a short distance along the posterior side of the humerus. The bones of the wrist are somewhat poorly developed as ossifications in the great mass of cartilage corresponding externally to the base of the flipper or pectoral limb. In an adult whale there are six of these bones arranged in two rows: four in the proximal and two in the distal row. Those of the first row are probably homologous with the radiale, intermedium, and ulnare of the typical vertebrate carpus with a large pisiform at the external side; possibly, however, the first represents a fused prepollex and radiale, as there is some evidence of two centers of ossification in this bone. The homology of the two small bones of the distal row is of great interest. In Balaenoptera as in Megaptera, there are but four fingers in the hand, and it has been generally assumed that, as is usual in cases of digit reduction, it is the thumb that has become lost. Kükenthal (1893), however, made the remarkable discovery that it is probably the third digit instead. For in at least two embryo Finbacks he found loosely imbedded in the tissue between the second and third fingers,



5 6 7

TEXT-FIGS. 5, 6, 7.—Shoulder blades of whalebone whales (from True, 1904).
5.—North Atlantic Right Whale (*Eubalaena glacialis*).
6.—Common Finback Whale (*Balaenoptera physalus*).
7.—Humpback Whale (*Megaptera nodosa*).

several vestigial phalanges which, he urges, probably represent the true third or middle finger. That this contention is correct, is additionally shown by the fact that the median nerve of the arm gives off *two* branches to the space between the present second and third fingers. In five-fingered animals there is *one* branch to each interspace, hence the presence of two branches in this case points to the former existence of another digit here. It follows, that since only the tip of this digit is still left in occasional specimens, its disappearance must have begun at the base, hence the corresponding carpale 3 may be considered lost. Leboucq has described a double ossification in the inner of the two distal carpalia, so it is considered by Kükenthal that this single bone represents a fusion of carpalia 1 and 2. The other existing bone is therefore either the carpale 4 or a fusion of the carpalia 4 and 5 of the primitive vertebrate hand. There is, however, no positive evidence that it represents a fusion of two elements.

Accepting Kükenthal's conclusion that the vestigial phalanges occasionally found in embryo Fin Whales between the second and third fingers, really represent the lost third digit, it results that the functional fingers correspond to digits I, II, IV, and V of the typical vertebrate hand. These consist each of a basal segment or metacarpal, succeeded by several bony or cartilaginous phalanges, the exact number of which varies somewhat, partly from the fact that in immature specimens they are not wholly bony. In the respective digits the number of these phalanges is given by Struthers as 4, 7, 7, 4 in an aged individual. The Gloucester specimen had 4, 6, 4, 2 on one side and 4, 6, 5, 2 on the other according to Dwight. In True's (1904, p. 143) table summarizing observations of several investigators, it is shown that for digit I, 3 or 4 is usual, rarely 2; for digit II, 6 is usual, rarely 5 or 7; for digit IV, rarely 4, usually 5, sometimes 6 or 7; for digit V usually 3, sometimes 2 or 4. Digits 2 and 4 have therefore regularly more than the usual three phalanges, a condition known as 'hyperphalangy.'

The *hind limb* is not present in the adult whale, yet in very small embryos its rudiment may be seen in the shape of a small papilla on each side of the anus. It does not develop, however, and must have been lost very long ago in the history of the race. The pelvic girdle likewise is poorly developed and is represented in the adult by two bones, situated one on each side imbedded in the flesh above the anus. They are somewhat triangular in form with an inner crescentic outline, and externally a large projection near one end, corresponding to the pubic element. They are supposed to represent each a half of the pelvis with the elements much reduced. That they have not wholly disappeared is probably because they still subserve a slight function for muscle attachment. On the lower and external side, held by ligaments on the curve between the pubis and ilium (or the points corresponding to these elements) is a small round nodule of bone which represents all that is left of the head of the femur. The size of the pelvic bones varies more or less. In the Society's specimen, which is an immature female, they are 8.5 and 9 inches long respectively but may be as long as 23 inches (Struthers) in an adult male, with a femoral nodule two inches long.

Movements and Spouting.

The actions and appearance of living Finbacks are somewhat characteristic, though it is not probable that the larger species of Balaenoptera can always be identified at sea. The first photographs published showing living Finbacks in the North Atlantic, are those of True (1903). Millais has also published a figure showing the spout of this whale, and Andrews (1909) has given an excellent series of photographs illustrating the spouting and other movements of the Pacific Finback (*B. velifera*), a very closely allied species. One's first view of a whale at sea is apt to be extremely disappointing, for instead of a huge bulk floating lightly on the surface, as pictured in the books of childhood, a very small portion only of the great

animal is exposed above water at a time. The characteristic positions of the shallow, surface dives made as the whale comes up to breathe several times in succession, are to be distinguished from those of the deep dive or 'sounding' made at the end of the series of shallow dives, when the whale, having refreshed its lungs, plunges below for a longer stay. On again coming to the surface from the depths, it rises obliquely, and at the moment the blowholes at the vertex of the head, are exposed, the vaporous breath is expelled with great force to a height which probably does not exceed fifteen or twenty feet (Andrews). The sound produced by this rush of breath is audible at a considerable distance and is said to be sharper than the noise made by the Humpback. The column of vapor is of characteristic shape, directed vertically upward, narrow at first, expanding evenly to the summit, like a thin-stemmed vase, without appearance of its double origin. As the cloud of vapor dissolves the inspiration takes place, the widely expanded blowholes close, the head is depressed slightly and as the forward part of the whale sinks under water, the top of the shoulders and back successively appear, until the high dorsal fin comes clear out. By this time the front part of the body is already sinking, and soon the ridge of the back and finally the dorsal fin disappear. The tail is not shown. Several of these shallow dives follow, at somewhat regular intervals usually about six to ten or twelve in succession. Andrews (1909) found that the Pacific Finback usually spouted about four times at fifteen-second intervals before sounding for a longer period. In sounding, the body is much more arched than in the shallow dives, and the whale goes down at a sharp angle. In ordinary course the whale may appear again in from four to fifteen minutes or longer (Andrews timed a Pacific Finback that was down for twenty-three minutes). It is unknown what the maximum time may be that a Finback can remain under water, but probably it is not above half an hour. It often happens that whales sound and are not again seen. No doubt in such cases they go a long distance and when next they rise to the surface, are too far away to be easily made out. The appearance of the spout may be modified by the action of the wind, or it may vary according to the force with which it is expelled and the amount of moisture contained in it and the surrounding air. It is not altogether the colder temperature of the air that causes the vapor to become visible through condensation, as in case of our own breath in winter; for the spout is equally visible under the tropics. No doubt the explanation, as first advanced by Racovitza (1903), is that the vapor becomes surcharged with moisture under pressure in the whale's lungs, and when violently expelled, it expands. This sudden expansion in accordance with a well known physical law, causes an immediate lowering of temperature sufficient to produce momentary condensation of the water particles contained, which therefore become visible as a 'spout.' It is strange how hard it is, nevertheless, to root out the idea that a whale spouts water engulfed through its mouth; and I have even known persons of education to believe that it spouted oil, manufactured within its blubber!

In diving, the whale leaves on the surface, an oval 'slick,' as the whalers call it, an area of water smoother than that surrounding it, due no doubt to the counter currents produced by the displaced water as the whale comes to the surface and withdraws. It is unlikely that it is due, as one author has supposed, to oil from the whale itself.

The Finback Whale seems but rarely to leap out of water. An instance of this sort, however, is reported in the Nantucket Inquirer for August 10, 1833, but the circumstances were peculiar in that the whale had accidentally run upon some rocks near shore, in the vicinity of Whitehead Light, Maine. After floundering about for some minutes, it managed to free itself, but was "evidently not a little agitated, throwing itself out of the water," as it approached a schooner nearby. Professor W. Kükenthal tells me that he has once seen this species 'breeching.' Usually however, it does not leap out of water.

Millais believes that the Finback can appreciably turn its head, notwithstanding its short neck. At all events this seemed to be the case in one instance he observed.

While feeding near the surface, the Finbacks often swim back and forth in the currents, and with open mouth engulf quantities of water containing small crustaceans or fishes. According to Andrews, they turn on their side, and the water, as the great mouth closes, is forced out between the baleen plates. At such times one of the pectoral fins and a lobe of the flukes may be protruded above water. "The animal [Pacific Finback] frequently rolls from side to side exposing nearly the entire length of the body."

Schools.

Although single Finbacks are often seen, it is commoner to find them in pairs or schools of greater or less numbers. When traveling in pairs, the two keep close together, almost side by side, diving and rising in unison. Where there is an abundance of food many of these whales will sometimes congregate, and occasionally multitudes are reported off our shores moving in open order and apparently in a concerted manner as if migrating. Such movements are more often noticed during early summer. The few instances following are given for what they are worth, and serve to indicate the size of some of the schools of Finbacks on our coast.

Captain B. F. Gardner, of the steamboat *George W. Donaldson* running between Newport, R. I., and Block Island, informed Major E. A. Mearns that almost every year Finbacks were seen, in schools of from six to twenty, usually in pairs.

A company of four Finbacks is reported in October, 1868, proceeding westward from Nantucket (Nantucket Inquirer and Mirror, vol. 49, no. 18, Oct. 31, 1868).

A school of whales, presumably Finbacks, was reported near Block Island, R. I., about the middle of July, 1884; they were estimated to be about twenty in number (Nantucket Journal, vol. 6, no. 42, July 17, 1884).

A school of Finbacks numbering about twelve was discovered off Cape Cod about the first of June, 1888, by the whaling steamer *A. B. Nickerson* (Nantucket Journal, vol. 10, no. 36, June 7, 1888).

What must have been an immense school of Finbacks was seen by officers of the United Fruit Company's steamer *Esparta,* when off Nantucket South Shoal Lightship about the middle of July, 1909. They were scattered as far as the eye could reach and were estimated to number "hundreds." According to the report they were heading north and "were evidently in pursuit of mackerel" (Nantucket Inquirer and Mirror, vol. 90, no. 3, July 17, 1909).

Great numbers of Finbacks were seen off South Shoal Lightship in the last part of August, 1913, by Mr. W. W. Welch of the U. S. Bureau of Fisheries.

In Scandinavian seas, Millais reports that a whaling captain observed near two hundred Finbacks in sight at once from the masthead. They were scattered over an area of some five square miles, singly or by twos and threes.

Rest.

As to the manner and time when these whales rest, and the duration of their inactivity, we are in almost utter ignorance. Probably they do actually sleep like other mammals, and this by day as well as by night. An intelligent Norwegian whaler with whom I talked on the Newfoundland coast, believed that Rorquals slept at night at the surface of the water, as shown by the fact that one night the whaling steamer while returning up Placentia Bay, ran into one. Yet collisions may occur when whales are attempting to cross a vessel's bows, so the incident is not conclusive. True (1904) quotes from an old narrative by a Franciscan monk, Sagard-Théodat,[1] written in 1632, concerning whales seen in the Gulf of St. Lawrence off Gaspé. He says (translated), "The first whale that we saw at sea was asleep, and as we passed quite close the ship was turned a little, for fear that upon awaking it might do us some harm." Again he says, "The *Gibars* and other whales sleep holding their heads extended out of the water, so that this blowhole is exposed and at the surface." The term *Gibar* seems to have been used to include Finback and Humpback Whales.

Accidents and Fatalities.

Of the larger Cetacea frequenting the New England coasts, the Finback Whale is the one most commonly found stranded. This may in part be due to the fact that it is the most numerous of the big whales, but I think, also that it comes in shore in pursuit of small schools of fish or enters shallow water more frequently than the Sulphurbottom or the Sperm Whale, and because of its large size is less able to escape from shallows than the smaller Humpback,

[1] Sagard-Théodat, G. Le Grand Voyage au Pays des Hurons, 1632.

Piked Whale, or Right Whale. Possibly it is at times chased by the relentless Killer Whales or Orcas into shallow water. In many cases Finbacks have drifted ashore that were killed at sea, but numerous instances have occurred in which the stranding of unhurt individuals has come about through accident. Most commonly these fatalities result from the whale having come close in to the shore, when a falling tide has left it stranded, or has cut off escape by lowering the water through the channel whence it entered some bay or harbor.

Captain N. E. Atwood writing from Provincetown, says, "I have known two of this species to run on shore in the night, in our harbor, and be left by the receding tide. When they were killed there appeared to be no indications of disease, and the cause of their running on the beach could not be learned." [1]

The Nantucket Inquirer of August 10, 1833, contains a note on the stranding of a "large Finback" off Whitehead Light, Maine, as witnessed by persons on the schooner *Experiment* bound from Salem to Northport. "The whale ran upon the rocks near the light, and after floundering some time, slipped off and came close to the schooner, evidently not a little agitated, throwing himself out of the water as he approached, and giving the vessel a sensible shock." In this case it would seem that the whale had come upon submerged rocks of which it had no warning and had been carried on to them by its momentum.

Mr. Roscoe C. Emery has kindly written out for me a short account of the accidental stranding of a Finback Whale on January 17th, 1912, near Eastport, Maine. The whale "had been in Cobscook Bay, but instead of returning to open water by swimming down the Lubec shore, chose to pass by the shallow channel north of this island (Eastport) between it and the mainland of Perry. In doing so it entered a pool blocked at one entrance by a railroad bridge and obstructed at the other by a sandbar. This sandbar, while covered at high water by a depth of perhaps ten to twelve feet, is left bare by the ebbing tide, and when the tide dropped kept the whale prisoner. Here it was noticed by two Indians, who waited until the receding tide left the whale stranded, when they dispatched it with bullets and harpoons." Probably the whale had been following a school of herring, and so had been lured in to the shore waters. At all events, a herring was found entangled in its baleen.

It is rarely that a large whale becomes entangled in a fish net, though this does occasionally happen, and on the Japan coast great nets are regularly used in the capture of Right Whales. The Nantucket Inquirer and Mirror (vol. 86, no. 23, June 23, 1906) gives an account of the adventure that befell one Henry S. Whorf of the mackerel drift-netter *Letha May*, who one night in mid-June, in his dory was tending the nets that stretched from the sloop's bow fully a mile into Provincetown Bay. The whale, probably a Finback, struck the net near Whorf's dory and becoming "enwrapped in countless thousands of three-inch meshes of

[1] In Allen, J. A. Mammalia of Massachusetts. Bull. Mus. Comp. Zoöl., 1869, vol. 1, p. 204.

coarse twine was unable to obtain a full supply of air, and exhausted by its long fight for liberty [and air], died at last, to the delight of the lone fisherman, who, with clothing saturated and dory deluged with water from the struggle, lost no time in clearing the net from the great animal which then sank from sight." Possibly the whale did not see the net at night, and so did not avoid it.

The same journal prints an item concerning a 60-foot whale (and hence doubtless a Finback) that "burst violently into the floating trap of a Provincetown fisherman" in early July, 1908. The whale caused considerable damage to the net but eventually freed itself and escaped (Nantucket Inquirer and Mirror, vol. 89, no. 2, July 11, 1908).

A similar instance is reported by H. F. Moore (Rept. U. S. Comm. Fish and Fisheries for 1896, 1898, vol. 22, p. 404) who says that Finback Whales in pursuing herring in Passamaquoddy Bay, Maine "sometimes enter the weirs and are killed, but occasionally the result is disastrous to the weir, a fine one at Grand Manan being almost ruined by a whale in September, 1893."

A number of cases are on record in which vessels have been in collision with whales, usually to the greater damage of the latter. The Nantucket Inquirer and Mirror (vol. 65, no. 48, May 30, 1885) gives an account of such an accident that befell the pilot boat *Alexander M. Lawrence, No. 4*, when some twenty miles east of Nantucket. The vessel was proceeding at about thirteen knots an hour, when it suddenly collided with a large whale, which struck it on the port bow. The *Lawrence* dipped until the water nearly reached her hatches and seemed in such imminent danger of capsizing that those below immediately rushed on deck. Looking back, they saw the whale rolling about as if in distress, but the vessel sustained no injury. No indication of the species of whale is given but it was most likely a Finback or Humpback.

A dead Finback Whale "about forty feet long, drifted ashore on the south side of Tuckernuck" about the 20th of June, 1904, which was thought to have been "one of those with which schooner *Adelia T. Carleton* was in collision" the week previous (Nantucket Inquirer and Mirror, vol. 84, no. 52, June 25, 1904).

The same journal relates that the steamer *Admiral Sampson* in mid-June, 1906, while proceeding through a fog off Chatham, Mass., came suddenly upon a whale that had risen to blow directly in the vessel's track. The chief officer grasped the whistle cord and gave a sharp blast, while the whale at once dove just in time to escape being cut in two by the sharp prow of the steamer. "Its huge body was just grazed by the starboard side of the vessel and it came up almost immediately astern and followed along for some distance as though bent on revenge" (Nantucket Inquirer and Mirror, vol. 86, no. 22, June 16, 1906).

Another instance is reported by Captain von Leitner of the steamship *Graecian*, a few summers ago. On July 28th, when two days out from New York, bound for the West Indies,

a whale was struck with such terrific force as to cut the animal into two parts. The captain had altered his course to avoid the collision, but was too late. The vessel was stopped and an examination of the propellors made to see if they had sustained injury from contact with the carcass, but no damage was discovered. There is no indication as to the species of whale killed. The Boston newspapers of September 17, 1913, chronicle a collision between a whale, of unknown species, and the Danish steamer *Wladimir Reitz*, some 250 miles east of St. John's, Newfoundland. The whale was not seen in time to avoid it, and it struck the ship head on, "knocking a four-foot hole in the bow" and necessitating a run to St. John's for repairs.

Captain Christaffersen of the whaling steamer *Puma*, told me in 1903, that while proceeding under full steam at night in Placentia Bay, Newfoundland, he had collided with a whale, which he supposed to have been sleeping at the surface. The shock woke the others of the ship's company, and it was at first feared that the vessel had struck a rock, though the water at that portion of the bay was known to be deep. In the darkness it was impossible to tell what injury the whale had suffered. In all these cases, it seems that the collision was quite by accident.

On the 25th of July, 1842, a Wellfleet fishing schooner found a dead Finback Whale floating off Plymouth, Mass., and took it in tow to Provincetown. On stripping off the blubber, it was found that the under jaw was broken in two places and otherwise much injured. At about the same time a Cohasset fishing schooner fell in with another dead Finback whose jaw was similarly broken. It was supposed that the two had been fighting, and so had fatally injured each other, but the usual peaceable nature of this species is rather against such a supposition. The sex of the dead animals is not given (see Nantucket Inquirer, vol. 3, no. 28, July 9, 1842).

It has occasionally happened that whales have become caught by the anchor of a moored vessel, and even sustained fatal injuries therefrom. Thus the Yarmouth (Mass.) Register (quoted by the Nantucket Inquirer, vol. 35, no. 100, Aug. 27, 1855) recounts that a whale, apparently a Finback, was caught by the anchor of the schooner *Valentine Doane*, of Harwich. So violent were the whale's struggles to free itself that it broke the anchor, but received such injuries in its frenzy that it shortly died and was later found floating on the surface. The broken anchor was on exhibition for some while at Harwichport.

An earlier instance of this nature is recorded by Paul Dudley in his famous essay on the natural history of whales: "A few Years since [previous to 1725]," he writes,[1] "one of the Finback Whales came into a Harbour near *Cape-Cod*, and towed away a Sloop of near forty Tun, out of the Harbour into the Sea. This Accident happened thus: It is thought the Whale was rubbing herself upon the Fluke of the Anchor, or going near the Bottom, got the Fluke

[1] Dudley, Paul. Phil. Trans. Roy. Soc. London, Abridged, 1734, vol. 7, pt. 3, p. 428.

into....the Orifice of the *Uterus*, and finding herself caught, tore away with such Violence, that she towed the Ship out of the Harbour, as fast as if she had been under Sail with a good Gale of Wind, to the Astonishment of the People on Shore, for there was nobody on board. When the Whale came into deep Water, she went under, and had like to have carried the Sloop with her, but the Cable gave Way, and so the Boats that were out after her, recovered it. This Whale was found dead some Days after on that Shore, with the Anchor sticking in her Belly."

On December 16th, 1874, "while the schooner *Sultana* was lying at anchor on Grand Bank, a sudden motion was felt by those on board, and it became evident that the craft was being carried through the water by some unseen and unknown power. Looking forward, it was observed that the cable was drawn taut, and that some 'monster of the deep' was attached thereto, and drawing the vessel along at the rate of twelve knots an hour. Soon they obtained positive evidence, as a mammoth whale came to the surface to blow, having the anchor of the vessel hooked either into his jaw or blow-hole. There was also another whale which swam near, evidently greatly astonished at the predicament of his companion. The men on board one of the dories, which had just returned from visiting their trawls, had barely time to make fast their painter ere the vessel started. Another dory, with two men, was at some distance, also visiting their trawls. The captain stood ready with axe in hand, in case of emergency, and allowed the whale to tow them some distance; but not wishing to lose sight of the men in the dory, was obliged to cut the cable." [1] A rough sketch by the ship's steward accompanies this account, and represents a whale with prominent dorsal fin (and so probably a Finback) towing the schooner.

These instances of whales becoming caught by the anchor of a vessel indicate that they occasionally seek the bottom at moderate depths, perhaps in pursuit of food, perhaps even to rest briefly on the sea floor, as seals will sometimes do. An interesting note in this connection comes from Captain Laffan of the U. S. cable ship *Burnside* which was sent north from Seattle, Washington, a few years ago to repair the cable from that city to Alaska because of the difficulty experienced that winter in sending and receiving messages. The *Burnside* picked up the cable connecting Valdez and Sitka a few miles off Cook's Inlet, and finally discovered the cause of the trouble. A large whalebone whale, probably while feeding near the bottom, had succeeded in taking the cable in its open jaws where it had become wedged between the whalebone plates. Unable to free itself, the whale had rolled and turned until the cable had become tightly twisted about its head, effectually holding it until it drowned. The carcass had been devoured by fish, but the great mass of whalebone was brought aboard by the crew of the *Burnside*. No indication of the species of whale is given in the brief account of this interesting casualty. More lately a somewhat similar case is reported from Ceylon.

[1] Anon. The Fisheries of Gloucester, from 1623 to 1876, etc. Gloucester, 1876, p. 64.

The Boston daily papers of January 13th, 1915, chronicle the disappearance of the Roaring Bull buoy off Pease's Island, N. B. The report states that the Canadian Government steamer, which went out to locate the missing buoy, found it at some distance from its station with a 50-foot whale entangled in its chain. Apparently the whale had dragged the buoy with its anchor, weighing in all 5,000 pounds until it had become exhausted and sunk.

Food.

The food of the Finback Whale consists in part of fish and in part of small pelagic crustaceans. On the Newfoundland coast, the stomachs of several Finbacks which I examined contained enormous quantities of the small shrimp-like schizopod, *Thysanoëssa inermis*. No doubt this is also eaten by the Finbacks on the New England coast, yet it is probable that other species too are taken. In his explorations in the Gulf of Maine in July and August, 1912, Dr. H. B. Bigelow (1914) failed to obtain *T. inermis* in the tow, at all, though other schizopods and copepods were abundant. This is the more interesting since Finback Whales are commonest in these months and several were seen by Dr. Bigelow on this cruise. He found the small copepod *Calanus finmarchicus* abundant, and the large schizopod *Meganyctiphanes norvegica* common. Undoubtedly both these are eaten by Finbacks. In a winter cruise, Dr. Bigelow obtained *Thysanoëssa inermis* on the south coast of Massachusetts commonly in the tow. Lillie (1910, p. 786) found that *Meganyctiphanes norvegica* composed nearly the entire stomach contents, so far as ascertainable, in a number of Finbacks killed off the west coast of Ireland in July and August. It is likely, therefore, that it is largely eaten on our own coasts by these whales in summer.

Fish of several species are consumed in great quantities but exact observations are difficult to obtain. Paul Dudley in his famous essay on the whales of New England, says of the Right Whale, that "their Swallow is not much bigger than an Ox's, but the Finback Whale has a larger Swallow: for he lives upon the smaller Fish, as Mackarel, Herring, &c. great Sculls [*i. e.* Schools] of which they run through, and, with a short Turn, cause an Eddy or Whirlpool, by the Force of which, the small Fish are brought into a Cluster; so that this Fish, with open Mouth, will take in some Hundreds of them at a time." No doubt the whirlpool supposed to be made by the whale in feeding is largely fanciful, but it is true that the Herring forms an important part of the food of the Finbacks on our coast. It will be of interest to consider briefly the occurrence of the herring on our shores in connection with the presence of these whales. H. F. Moore [1] has written an extensive treatise on herring fishing in the region of Passamaquoddy Bay, Maine, from which the following notes are extracted.

[1] Moore, H. F. Observations on the herring and herring fisheries of the northeast coast, with especial reference to the vicinity of Passamaquoddy Bay. Rept. U. S. Comm. Fish and Fisheries for 1896, 1898, vol. 22, p. 387–422, pl. 60–62.

In the western Atlantic Ocean the herring ranges as far south as Cape Hatteras, but never occurs in great abundance south of Block Island. The principal fisheries are from Cape Cod to Newfoundland. The small herring and some of the larger ones are found throughout the year on the coast of Maine. During the winter they apparently keep in the deeper water, but catches have occasionally been made in the weirs during February. In spring they approach the shores and the weirs are tended regularly from April 1 till the following January. Comparatively few are taken in Passamaquoddy Bay till July and August. Strong currents and eddies, such as "the Ripplings" off Grand Manan are much frequented by the herring schools on account of the abundance of food that tends to collect in such places.

The herring feed chiefly on small copepods (Calanus) called "red seed," and Thysanopoda or "shrimps" (*? Thysanoëssa*) which occur in enormous numbers. During the winter there is a comparative dearth of animal life at the surface, due in part to the winds which at this season cause more sea so that surface life seeks deeper levels. "During the summer these shrimps are extraordinarily abundant in the Passamaquoddy district, but it is said that they are not often seen at the surface in winter; but if this be true, they no doubt abound at a distance from the surface where the temperature is more equable." In summer and fall both copepods and thysanopods are found near the surface, often in such dense masses as to impart a distinct reddish tinge to the water. Herrings appear to feed principally at night but in late summer and early fall immense schools of the young may be seen at the surface at all hours of the day. Mackerel are said to feed extensively on young herring. Westward from Grand Manan the spawning ground for herring is almost continuous along the coast to Wood Island, Maine, and thence in places as far southwest as Block Island, Rhode Island. In the vicinity of Machias Bay the herring usually appear after the middle of July and remain until late in September. At Frenchman's Bay the 'net' herring arrive during June and remain till late in October.

I am indebted to Mr. E. Ralph Haskell of Ipswich, who has had much experience with herring on the New England coast, for the following interesting notes. "In July or August great schools of small herring, the sardine of the Maine coast, arrive off eastern Massachusetts and remain, appearing at intervals, until the departure of the larger fish. The latter arrive for spawning about the twentieth of September but the exact date may vary a great deal. They are not numerous until the first of November. The spawning season in this vicinity is from October first until November first and scattering schools can usually be found during the first week of December. Some years they have remained until the first part of February. As the herring do not spawn south of Eastport, Maine, in the spring, there is no spring 'run' of them here."

Mitchell[1] in his monograph on the herring, considers it the most abundant fish in the

[1] Mitchell, John M. The herring, its natural history and national importance. Edinburgh, 1864, xii + 372 pp., illus.

North Atlantic, a statement that may readily be believed by one who has seen the myriads of them that occasionally are cast on our shores. In August, 1911, for example, I witnessed such a tremendous destruction of young herring a few inches long, that they were heaped in windrows along the shores of Rye Beach, N. H., for miles. Indeed so great was the quantity of dead fish, that steps had to be taken by the people residing near, to bury some part of them.

Mitchell notes that on the Norwegian and Scottish coasts herring are frequently pursued or accompanied by schools of whales and other animals that prey upon them. He specifically mentions that in the Bay of Cromarty, in 1780, a large shoal of herrings appeared, accompanied by numbers of whales and porpoises beating the water into a foam for several miles, giving it the appearance as if ruffled by sudden land squalls. Again, in 1816, on the coast near Fraserburgh, a shoal of herring was accompanied or pursued by about one hundred whales of various sizes which remained seven days, from the 24th to 30th of August, in the same locality. The herring were of good size, full of milt and roe. The whales may thus indicate to the fishermen the presence of these fish, as in case of one who, fishing off Stornoway, Scotland, while the other boats were unsuccessful, was induced, through the appearance of a whale at a certain distance, to cast his nets near the whale, with the result that he took forty-eight barrels of very superior herring, though the other boats obtained only small quantities.

On the New England coasts the Finback Whales pursue the herring as on the European shores, and the appearance of both is frequently simultaneous. The springs of 1880 and 1881 were remarkable for the great numbers of these whales that came in shore along the Massachusetts and Maine coasts apparently in pursuit of herring. Thus Clark [1] relates that "early in March, 1880, there came into Provincetown Bay and harbor immense quantities of herring and shrimps. They were followed by a great number of finback whales which were here most of the time in greater or less numbers until about the middle of May, when they all left.... Early in June immense quantities of sand eels (*Ammodytes*) came in our harbor and bay and remained here several days. About the 10th of June there appeared plenty of whales feeding on the sand eels." Mitchell writes that herring feed on the sand eels so that possibly the whales may have been in pursuit of herring, which in turn were preying on the sand eels. Clark, however, does not mention herring with them. He later says that in the spring of 1880, these whales were so "abundant in Ipswich and Massachusetts Bays...that fishermen in their dories were in some cases alarmed for their own safety, as the whales were darting about in pursuit of schools of herring."

In the latter half of October, 1874, large numbers of whales, apparently Finbacks, were present in Vineyard Sound, and off Cuttyhunk, Gay Head, and Noman's Land, pursuing the herring that were there in great abundance for the fall spawning.

[1] Clark, A. Howard, in Goode's Fisheries and Fishery Industries of U. S., 1887, sect. 2, p. 230.

April 23, 1896, a "good-sized school of whales" is reported about Cape Cod as following the herring school.

About March 15, 1899, two large Finbacks were reported in Provincetown Harbor "in pursuit of scattered schools of small herring, and for an hour or two rushed about in plain view of many fishermen who made no attempt to capture them. They were the first of the spring school to enter the harbor, though several were seen in the offing more than a fortnight" before (Nantucket Journal, vol. 21, no. 24, March 16, 1899).

What was said to have been the largest school of Finback Whales seen in Massachusetts Bay since 1881, was reported in early February, 1905, pursuing the large herring then in those waters (Nantucket Inquirer and Mirror, vol. 85, no. 32, Feb. 4, 1905).

An item in the Nantucket Inquirer and Mirror (vol. 81, no. 30) for January 20, 1901, reports that "whales and herring have appeared off Provincetown. The fishermen have caught many of the latter." It is rather unusual for the herring to appear in numbers at this season, but their presence explains that of the whales, which doubtless were in pursuit of them.

H. F. Moore (1898, p. 404) writes that in Passamaquoddy Bay, Maine, "finback whales feed upon herring, but, though occasionally seen in summer, do not appear in numbers before October. A letter from Mr. McLaughlin, dated December 30 [1895], says that 'for ten days a large school of herring and whales has been off this station' (Southern Head, Grand Manan). The whales sometimes enter the weirs and are killed."

Mr. Roscoe C. Emery, of Eastport, Maine, writes me in regard to a Finback Whale stranded near there January 17, 1912, that "a large herring trapped in its baleen showed that it had been feeding on herring."

Millais reports that a Finback brought in to one of the Shetland stations contained in its stomach many large herring still unspawned.

These few references are sufficient to show that the Finback Whales follow the schools of herring and destroy large quantities not only of small ones but also of large fish about to spawn. If, as is supposed, the herring seek deeper water during the colder months, it seems probable that they go too deep for these whales to follow, since their return shoreward is coincident in marked degree with the reappearance of the whales (see under heading of Manner of Occurrence). The presence of the herring may in turn, depend largely on that of the minute crustaceans which constitute so large a portion of its food, and these too largely desert the surface waters during the inclement season. The whales feed upon both herring and crustaceans and thus their movements are in part regulated by the migrations of both these latter.

I know of no positive evidence that this whale feeds on mackerel on our coasts, although it is said to do so. Paul Dudley includes this, with herring, as one of the species preyed on by the Finback. In 1861, a whale was killed that had appeared off Nauset "in the midst of a fleet of some 200 mackerel fishermen" (Barnstable Patriot, Nov. 12, 1861) but this is not

sufficient proof that the whale was in pursuit of the mackerel. A large school of whales, probably of this species, was reported in mid-July off Nantucket Shoals, as "heading northward" and "evidently in pursuit of mackerel" (Nantucket Inquirer and Mirror, vol. 90, no. 3, July 17, 1909) but it seems quite as likely that in this and other similar cases, the mackerel were merely associated with the whales in following the small herring or other prey. Fishermen on the Maine coast also tell me that mackerel are eaten by the Finback and though this may be the case, positive confirmatory evidence is much needed. Mr. J. Henry Blake informs me that the mackerel fishermen sometimes report that these whales come up under their nets and engulf some of the fish they are endeavoring to seine. A Finback killed in the Shetland Islands, June 8, 1905, was found to have devoured herring, mackerel, and a dogfish, the last no doubt, engulfed accidentally with the other fish (Millais).

On the Labrador and Newfoundland coasts the Finbacks devour enormous numbers of capelin (*Mallotus villosus*), a small fish with the general appearance of a smelt. The stomachs of several Finbacks I examined at Placentia Bay, Newfoundland, in 1903, were entirely filled with these fish. Like the herring they move in vast shoals so that the whales can readily engulf them in quantity.

Brown (1868, p. 547) in writing of the Cetacea of the Greenland seas, observes that Finbacks eat cod and that he has known of eight hundred being found in the stomach of one. Brown was a naturalist of some repute, but his statement seems to need verification. Moreover, eight hundred cod might be a large meal even for a whale. Low (1906), in the Cruise of the Neptune, implies that these whales pursue the shoals of cod into the waters of northeast Labrador. More precise evidence on this matter is greatly to be desired.

Breeding Habits and Young.

Almost nothing is known in a definite way, concerning the breeding habits of the Balaenopterae. Copulation takes place at the surface but it is not clear that there is any special rutting season though Guldberg (1886) concludes that pairing takes place early in the year. The Nantucket Inquirer of August 21, 1833, reports what was probably a mating of these whales in Massachusetts Bay in early August of that year. A Captain Ezra Smith observed three whales together, one larger and two smaller. From the larger whale, estimated to be some seventy feet long, a "horn or something else, rose straight up, he should judge from ten to fifteen feet, about the size of a barrel at the bottom and a hat at the top." No doubt this "horn" was the whale's extruded penis, and the animals seen were pairing. The fact that individuals may be taken at the same time of year, containing foetuses of various stages of growth, seems to indicate much variation in the time of breeding. The period of gestation is believed to be probably a year or thereabouts, but there is no way of proving this. The New-

foundland whalemen told me that small foetuses could be obtained in the spring, but that gravid females taken in the fall had usually large foetuses nearly ready for birth. A single young one is produced at a birth, though rarely there may be twins. I was informed by the whalers at a Newfoundland station in 1903, of a female taken in Placentia Bay about September 4, 1903, in which two foetuses were found, each about twelve feet long. The two were said to be a male and a female. Other cases of twins are known but are very rare. We are in almost total ignorance of the manner and place of birth, but according to the Newfoundland whalers, the females seek the quieter waters of the bays in fall and there bring forth the young. At this season, they say, the females are very wild and difficult to approach. This may well be the case, for all the six whales taken during my stay in mid-September at Placentia Bay were males. The young at birth is nearly a quarter the length of its parent. True (1904) records a female of 67 feet that contained a foetus 15 feet 2 inches long; she was captured off Newfoundland on August 15th. Slightly longer foetuses are recorded, but 18 feet is probably about a maximum length. The baleen or whalebone is formed late in embryonic life and is not visible in even fair-sized foetuses. Millais (1906) mentions one of seventeen feet in length in which the baleen was just beginning to show in the gums.

In the Museum of Comparative Zoölogy are the bones of a foetal Finback collected by Mr. J. Henry Blake at Provincetown about the middle of June, 1881. The foetus could hardly have been a yard in length when removed. I know of no authentic case of young Finbacks being found on our coast.

Range.

The Finback Whale is cosmopolitan, and occurs in all the large oceans, but it is currently supposed that the Finbacks of the Southern Ocean and those of the Pacific represent species distinguishable from the Common Finback of the North Atlantic. The latter is limited in its northward range by the ice pack of the Arctic Ocean. In the summer, it advances to the open seas about Spitzbergen, following the northeastern extension of warmer water. On the western side of the Atlantic, however, it is uncommon much above Davis Straits, where in summer it devours great numbers of small fish on the cod banks — probably capelin for the most part. It apparently does not penetrate into Hudson Bay — at all events I have found no record of it, — but may follow the open water in Baffin's Bay at least as far north as Melville Bay on the west coast of Greenland, where on June 9th, Lindsay (1911, p. 132) mentions seeing a single one, as an unusual occurrence. It is said to be absent from the Newfoundland waters from January to the last of May.

Occurrence in New England Waters.

In general, Finback Whales do not approach our coasts closely except near outlying islands or the outstretched arm of Cape Cod, which projects as a narrow strip of land many miles out to sea and by its recurved tip seems often to intercept schools of whales moving at some distance eastward of the general coast line. Fishermen with whom I have spoken, agree that the Finbacks are usually seen at some distance from shore. Mr. George Dobson, of Rockport, Mass., tells me that though he has often seen them well offshore they rarely come in as near as the outer islands. They particularly frequent areas where the plankton is most abundant. Off Cape Ann and in the northwest part of the Gulf of Maine seem to be favorite haunts, and particularly the waters south and east of Cape Cod. Whales seem rarely to enter Long Island Sound from the western end as their general movement is too far to seaward, but they are sometimes found at the eastern entrance, as far west as Block Island, R. I., or eastern Connecticut, but records for the latter State are few. Major E. A. Mearns sends me the note that Captain B. F. Gardner who was pilot and captain of the steamboat *George W. Donaldson*, running between Block Island and Newport, R. I., from 1880 to 1896, reported that almost every year Finbacks were seen on this run, usually in pairs, or in schools of from six to twenty. Whales often are seen from the Nantucket shores, or occasionally from the Maine islands, but it is seldom that they are seen from the mainland. Nevertheless individuals now and then come close in and may even enter the harbors, as they have been known to do at Eastport, Portsmouth, Gloucester, New Haven, and elsewhere. Such temerity not infrequently results in their becoming stranded and summarily dispatched by the 'longshoremen.

The movements of this species show a rather marked periodicity, for they are much more frequently seen in the warmer months than in winter. Yet there seems to be no definite migration season as there is with the Atlantic Right Whale, for they may be noted at any time of year. In the following pages are brought together what definite records I have found for Finback Whales in New England waters. They can at best represent but a small fraction of the known occurrences, yet are I think, sufficiently numerous to indicate in a general way the seasonal distribution of the species. On page 218 I have summarized these records in tabular form and discussed them in more detail. In some cases where schools of whales are reported it is possible that other species than Common Finbacks were present, but the records are given for what they are worth.

1614.— Captain John Smith's narrative of his voyage to New England gives us the first definite reference to Finback Whales on this coast. In the month of April, in this year, he "chanced to arrive" off the coast of Maine, near Monhegan Island, and here found many whales and "spent much time in chasing them." But the whales proved not to be the Right Whale as he had expected, but instead "a kind of jubartes," *i. e.* Finbacks, and owing to their

strength and swiftness the hardy adventurers were unsuccessful in their attempts to capture any (Capt. John Smith: A Description of New England. London, 1616; reprint in Coll., Mass. Hist. Soc., 1837, ser. 3, vol. 6, p. 103).

1629.— An early reference quoted by True (1904, p. 22) makes a brief mention of whales, probably Finbacks or Humpbacks, seen in the Gulf of Maine, a day's voyage to the southeast of Cape Sable, and within sight of the Maine coast. "Thursday [25th June] wind still N. E. a full and fresh gale. In the afternoon we had a cleare sight of many islands and hills by the sea shoare. Now we saw abundance of mackrill, a great store of great whales puffing up water as they goe, some of them came neere our shipp; this creature did astonish us that saw them not before; their back appeared like a little island" (A True Relation of the last Voyage to New England, begun the 25th of April, 1629, written from New England, July 24, 1629. Hutchinson's Coll. Orig. Papers on Hist. Mass. Bay, 1769). Shortly after the same writer mentions again "huge whales going by companies and puffing up water-streames" (*ibid.*, p. 46). No doubt these whales, in large schools, were Finbacks following shoals of small fish with the mackerel.

1719.— A Finback Whale is reported washed ashore at Nantasket, Mass., the last of February (Boston Gazette, Feb. 28, 1719).

1808.— "Off the Brimbles, a whale, sixty feet long [and so a Finback?], is found dead, by some men from Marblehead. They towed it to Salem neck. It was visited by many from this place, till carried to Boston " (J. B. Felt: Annals of Salem, 1845, ed. 2, vol. 2, p. 95).

1828.— In this year, apparently, "a whale was brought on shore at Whale Beach, Swampscott, on the second of May. It was sixty feet in length, and twenty-five barrels of oil were extracted from it" (A. Lewis: History of Lynn, 1829, p. 236). From its length (60 feet) it seems probable that this was a Finback.

1833.— What may have been a small Finback, forty feet in length, was picked up at sea and towed into Gloucester Harbor about the last of July (Nantucket Inquirer, July 31, 1833).

A large Finback was seen off Whitehead Light, Maine, by the schooner *Experiment* bound from Salem to Northport, Maine, in early August. "The whale ran upon the rocks near the light, and after floundering some time, slipped off and came close to the schooner, evidently not a little agitated, throwing himself out of the water as he approached, and giving the vessel a sensible shock" (Nantucket Inquirer, Aug. 10, 1833).

From a Haverhill paper comes the report of three whales seen in Massachusetts Bay in the first half of August — a large one and two smaller ones. According to Capt. Ezra Smith, who made the report, the large whale was estimated at some 70 feet in length (Nantucket Inquirer, Aug. 21, 1833). Probably they were Finbacks.

1834.— An item in the New Haven Herald of about the 5th of May gives an account

of a whale, "about 60 feet in length," that came into the New Haven harbor at that time. Three boats put out in pursuit, and one "had approached in position to harpoon him, when a gun from one of the other boats caused the animal to sheer.....Passing by the wharf, he struck aground near the shore, where he was attacked and killed" (Nantucket Inquirer, May 10, 1834). From its length (60 feet), it is probable that this may have been a Finback.

The Gloucester Telegram for 1834, recounts that a "whale more than sixty feet in length, of the fin-back species, was towed into our harbor....by a fishing vessel" about the 25th of June. The item adds, "it had apparently been dead for some time."

Shortly after, about the 5th of July, a "large whale," probably also a Finback, "entered Gloucester Harbor and proceeded up as far as Five Pound Island. He was attacked by a number of men in a small boat, who fastened to him with a harpoon. The whale towed them with great velocity to the mouth of the harbor, when not having a proper instrument wherewith to despatch him, they were obliged to cut" (Nantucket Inquirer, July 9, 1834).

1836.— According to the Newburyport Herald, "a large Finback Whale" was captured at the mouth of Portsmouth Harbor about the 20th of May. Two boats manned by eleven men chased it for five hours. A Nantucket whaleman, Charles H. Gardner, threw two harpoons into it and after an hour's struggle it succumbed. It is not unlikely that this was a Humpback Whale, for its length is given as but 35 feet notwithstanding it was said to be "large."

1842.— The Nantucket Inquirer of July 9, 1842 (vol. 3, no. 28) records the finding of a dead Finback, about 55 feet long, near Plymouth, June 25th. It was towed to Provincetown where its blubber was removed. A few days afterward a second dead Finback was picked up by a Cohasset fishing schooner. Both whales had the lower jaw badly broken, due as some thought, to a fight between the two.

1846.— About the 10th of December "two large Finbacks were seen playing side by side in Provincetown harbor." One of these was killed and reported to be over fifty feet long (Nantucket Inquirer, vol. 26, no. 142, Dec. 14, 1846).

1854.— The Nantucket Inquirer of July 7, 1854 (vol. 34, no. 80) records the capture of a "large Finback Whale" a short distance outside Nantucket Harbor, on July 6th.

1855.— A Finback Whale was seen off Provincetown on November 17th and although struck by a harpoon from a boat, it managed to clear itself and escape. Several others had been seen in Provincetown Harbor within a few days previously (Nantucket Inquirer, vol. 35, no. 137, Nov. 21, 1855).

1856.— About May 25th, a Finback Whale was reported by Capt. Luther Bowman, Jr., of Mattapoisett. It came within an oar's length of his boat off Bird Island, Mass. and "appeared of a size to yield 25 or 30 bbls. of oil" (Nantucket Inquirer, vol. 36, no. 90, May 26, 1856).

About November 20th, a "dispatch by the Cape Cod Marine Line says that a large school

of Finback Whales passed by Highland Light [Cape Cod], Friday, bound north" (Nantucket Inquirer, vol. 36, no. 142, Nov. 24, 1856).

1857.— About April 15th, Finback Whales came into Provincetown Harbor. Two were harpooned but escaped (Nantucket Inquirer, vol. 37, no. 41, Apl. 20, 1857).

1858.— About March 25th, "a Finback Whale, 62 feet in length, was found ashore on the south side of Martha's Vineyard." It was estimated to yield some 25 barrels of oil worth $400.

October 28th, "a large whale" was reported off Point Judith, in Long Island Sound. It remained in sight for some while and when last seen was proceeding in the direction of Block Island. Probably it was a Finback, though there is nothing to indicate this definitely.

1859.— Professor A. E. Verrill writes (The Bermuda Islands, 1902, p. 275) that in late July and early August he observed at the entrance to the Bay of Fundy large schools of Humpbacks with some Finbacks. "They were especially numerous at the seining grounds known as the 'Ripplings' east of Grand Menan Island, towards the center of the Bay, where the strong opposed tidal currents make a large area of very rough water during flood tide." The whales were feeding on herring and shrimps that had gathered here.

1861.— About June 20th, a Finback, 63 feet in length was found on the beach at Smith's Point, Nantucket. It had evidently been dead several days.

1868.— About October 25th, four Finback Whales were seen off Nantucket and unsuccessfully pursued by a boat's crew from the town (Nantucket Inquirer and Mirror, vol. 49, no. 18, Oct. 31, 1868).

In the autumn of this year, a Finback over sixty feet long was lanced and killed by boats pursuing Blackfish at Cape Cod. It made about twenty barrels of oil (G. B. Goode: Fisheries and Fishery Industries of U. S., 1884, sect. 1, p. 28).

1870.— April 1st, a Finback was picked up dead near Chatham, Mass., by a Nantucket schooner. It measured about 63 feet in length and yielded about 22 barrels of oil. The cause of its death was not discovered (Nantucket Inquirer and Mirror, vol. 50, nos. 40, 41, Apl. 2 and 9, 1870).

About October 20th, a whale was captured about ten miles off Gloucester, and was towed to Boston.

1871.— About the 20th of October two dead whales were found in Nantucket waters. One drifted ashore at Siasconset, the other was picked up in the vicinity of Tuckernuck Shoals. From the small amount of oil produced, it is probable that both were Finbacks (Nantucket Inquirer and Mirror, vol. 52, no. 11, Sept. 9, 1871).

A Finback captured off Gloucester, Mass., in October was made the subject of a memoir by Dr. Thomas Dwight (Mem. Boston Soc. Nat. Hist., 1872, vol. 2, p. 203–230, pls. 6, 7) and its mounted skeleton is preserved in the Society's Museum.

November 25th, a whale of this species came ashore dead at Point Shirley, Boston Harbor (T. Dwight: Proc. Boston Soc. Nat. Hist., 1872, vol. 15, p. 26–27).

1872.— About the 10th of December, a Finback appeared in Provincetown Harbor and at once became the object of pursuit by a boat's crew under the leadership of Capt. Isaac Fisher. After receiving three lance thrusts the whale finally parted the harpoon line and escaped (Nantucket Inquirer and Mirror, vol. 53, no. 24, Dec. 14, 1872).

The Boston Semi-Weekly Advertiser of February 27, 1872, reports a "large Finback Whale, forty feet in length" that got aground on the flats near Wellfleet, Mass.

1873.— "A Connecticut paper, dated August 16, 1873, states that the skipper of the sloop *Annie*, of Saybrook, Conn., reports a large school of whales in close proximity to home. Monday, while midway between Southeast Point, Block Island, and Montauk, a school of whales, numbering probably thirty-five, was seen from the *Annie's* deck, gamboling near the Block Island shore, where they had been lured, it is supposed, by the prospect of a good feeding-ground. In the school very few Finbacks or Humpbacked whales were to be seen. The majority were large whales, some of them being not less than 70 feet in length. Boatmen report it as a common occurrence to see two or three Finbacks in company in the race, but the appearance of so many large whales is a new experience" (A. Howard Clark, in Goode's Fisheries and Fishery Industries of U. S., 1887, sect. 5, vol. 2, p. 48).

1874.— During the latter half of October in this year "large schools of whales" (probably mostly Finbacks) were reported seen from Noman's Land, Gay Head, and Cuttyhunk, Mass. "In Vineyard Sound large numbers were seen near the shores and the light boat off Sow and Pigs." On October 23d, ten were seen at one time. One, a Finback, was shot with a bomb-lance near Cuttyhunk. In all four were shot, but they sunk and were not recovered. It was said that the great shoals of herring then in the Sound spawning had attracted the whales (Forest and Stream, vol. 3, p. 188, Oct. 29, 1874).

1875.— About the 15th of August a whale was washed ashore on the south side of Smith's Island, near Tuckernuck, Mass. The report states that it was a Sulphurbottom, but its length given as 42 feet, would seem to render this doubtful. It yielded but three barrels of oil (Nantucket Inquirer and Mirror, vol. 56, no. 8, Aug. 21, 1875).

1876.— About the 15th of October, a Finback was seen near shore at Quidnet, Nantucket. The same or another Finback was seen in the bay four days later (Nantucket Inquirer and Mirror, vol. 57, no. 17, Oct. 21, 1876).

1878.—About the 25th of July a dead Finback Whale was discovered floating off Sankoty, Martha's Vineyard (Nantucket Inquirer and Mirror, vol. 59, no. 5, Aug. 3, 1878).

A "small Finback" was reported as seen for several days in succession off the east side of Nantucket, during the last week of October. It may have been of some other species than that under consideration (Nantucket Journal, vol. 1, no. 6, Oct. 31, 1878).

1879.— September 12th, four were seen swimming and spouting in Provincetown Harbor (G. B. Goode: Fisheries and Fishery Industries of U. S., 1884, sect. 1, p. 28).

About November 5th, "a large Finback Whale" was reported as seen by Captain Obed Swain off the south shore of Nantucket (Nantucket Inquirer and Mirror, vol. 60, no. 19, Nov. 8, 1879).

A mounted skeleton in the Museum of Comparative Zoölogy was obtained at Cape Cod in this year.

1880.— About March 25th, a large Finback, estimated to yield 25 barrels of oil, was found floating near the South Shoal Lightship, off Nantucket (Nantucket Journal, vol. 2, no. 27, Apl. 1, 1880).

On April 18th a very large Finback stranded near the Life Saving Station at Wakefield, R. I., according to the record of Mr. H. M. Knowles, Keeper. "Its belly was a yellowish white resembling porcelain" (so a Finback). It was supposed that it had been on exhibition somewhere, as its body cavity "contained several kerosene barrels to round it out" (Major E. A. Mearns).

A. Howard Clark, writing from Gloucester, Mass., May 13, 1880, says, "Whales have recently been numerous in this vicinity, and shore boats report many of them swimming about. Four dead ones have been towed into this harbor; the largest was 65 feet long." (Bull. U. S. Fish Comm., 1884, vol. 4, p. 404). The last from its length was doubtless a Finback, and the others were probably the same species, in large part at least.

About June 20th, a Finback some sixty feet long washed ashore on Nantucket to the southward of Maddequecham Valley. Probably it had been killed outside the Cape by the Provincetown whalers (Nantucket Journal, vol. 2, no. 30, June 24, 1880).

"Early in March, 1880, there came into Provincetown Bay and harbor immense quantities of herring and shrimps. They were followed by a great number of finback whales, which were here most of the time in greater or less numbers until about the middle of May, when they all left.....Early in June immense quantities of sand eels (*Ammodytes*) came in our harbor and bay [Provincetown] and remained here several days. About the 10th of June there appeared plenty of whales, feeding on the sand eels." Forty-eight in all were killed by the Provincetown whalers by the use of bomb-lances (A. Howard Clark, in Goode's Fisheries and Fishery Industries of U. S., 1887, sect. 2, p. 230).

A further echo of the activities of the local whalers comes in a note from Gloucester, Mass., under date of July 23d: "Recently a carcass of a Finback Whale 55 feet long drifted ashore on Long Beach, some ten miles from here, opposite Milk Island" (A. Howard Clark: Notes on the Fisheries of Gloucester, Mass. Bull. U. S. Fish Comm., 1884, vol. 4, p. 407). The jaws of what is probably this specimen, are now exhibited in the museum of the Peabody Academy at Salem.

Mr. J. Henry Blake gives me a note of a Finback that he examined on December 4th at Litchfield's dock, Boston.

1881.— "In the spring of 1881, the whales came into the [Provincetown] bay again, but not in so large numbers [as in 1880, see *antea*]. Fifteen were killed which furnished 300 barrels of oil.... No whales have come in of late" (1887) (A. Howard Clark, in Goode's Fisheries and Fishery Industries of U. S., 1887, sect. 2, p. 230).

About the 25th of May a dead Finback, estimated as about sixty feet long was found floating a few miles outside Nantucket Harbor. It finally washed ashore near Capaum Pond and since there were no tryworks at Nantucket, it was towed to Dennisport on Cape Cod to obtain the oil (Nantucket Journal, vol. 3, no. 34, May 26, 1881).

In the Museum of Comparative Zoölogy are the bones of a foetal Finback collected by Mr. J. Henry Blake, at Provincetown about the middle of June. In a letter, accompanying the specimen, and dated September 8, 1881, Mr. Blake states that fifty-seven whales were killed and brought in there that spring.

The Nantucket Journal of November 10th (vol. 4, no. 6) records that a few days previously several whales were seen sporting off the south side of Nantucket.

Professor J. S. Kingsley informs me that these whales were abundant in Ipswich Bay in August of this year.

1882.— A report from Gloucester, Mass., under date of May 7th, notes that "whales are close to the shore" (S. J. Martin: Bull. U. S. Fish Comm., 1882, vol. 2, p. 17). No doubt these were Finbacks following the schools of fish in toward shore.

Whales, probably Finbacks, were said to have been seen in numbers about Block Island, presumably in the early summer (Nantucket Journal, vol. 6, no. 42, July 17, 1884).

According to J. F. Brown a male "Finback calf" was entangled in the net of a fish weir in Provincetown Harbor, early in October, and was drowned (Bull. U. S. Fish Comm., 1883, vol. 3, p. 411). The size is not given, and although the chance of its being a Little Piked Whale is not excluded, yet Mr. Brown's testimony may perhaps be accepted.

Major E. A. Mearns sends me a note of a large female Finback (said to be over 100 feet in length!) that stranded on the east shore of Narragansett Pier, R. I. A cord or two of pine wood and several loads of straw were required to burn it up. The exact date is unobtainable.

1884.— About the 10th of July, according to the Nantucket Journal (vol. 6, no. 42, July 17, 1884), "several whales were [seen] near Block Island and on Friday a shoal of perhaps 20 played for hours about a mile east of the island. One of the whales was seen very closely, and his length is estimated at 40 or 50 feet. Whales were quite numerous in that vicinity two years ago, but only one or two were seen last year. It is stated that when whales are seen, swordfishing is at its best, but the reason for this is not definitely known." Doubtless these were Finbacks, in part at least.

1885.— In early March and April, the fishermen at Gloucester reported that they had

"never seen whales so numerous on the eastern shore," and at least four small steamers from Maine and Cape Cod were in pursuit of them. Many were killed, which from the measurements and yield of oil, appear to have been chiefly Finbacks (W. A. Wilcox: Bull. U. S. Fish Comm., 1885, vol. 5, p. 169; S. J. Martin, *ibid.*, p. 207).

July 3d, a male Finback 56 feet long, came ashore at Mount Desert Light Station, Maine. It had probably been killed by whalers from Maine or Provincetown (C. W. Smiley: Bull. U. S. Fish Comm., 1885, vol. 5, p. 337).

Mr. John F. Holmes, keeper of the Gurnet Life Saving Station, 4½ miles northeast of Plymouth, Mass., reports that on July 5th, schools of whales and porpoises appeared near that station. The former were no doubt Finbacks in pursuit of small fish and were followed by mackerel, of which on July 7th, "a large quantity was taken" (C. W. Smiley: Bull. U. S. Fish Comm., 1885, vol. 5, p. 347). This same abundance of Finbacks was reported by Captain J. W. Collins, who on July 13th, found these and swordfish in unusual numbers between Brown's Bank and the northeastern extremity of George's Bank. "As many as 20 whales were seen at one time during the morning, and a still greater number were seen during the afternoon. At station 2528 [lat. 41° 47′ N.; long. 65° 37′ 30″ W.] they were very numerous, apparently feeding on small crustacea, probably from 40 to 50 whales being in sight at one time. They were all Finbacks, so far as I could tell. Their movements were sluggish, as they 'played' back and forth in the tide rips, with their mouths open, the upper jaw just at the surface, scooping in 'feed'" (J. W. Collins: Bull. U. S. Fish Comm., 1886, vol. 6, p. 381).

1885.— On July 7th, Capt. Joshua Nickerson shot one in Massachusetts Bay. Many squid in Provincetown Harbor at this time (J. Henry Blake).

The Nantucket Inquirer and Mirror (vol. 65, no. 48, May 30, 1885) recounts that on May 12th, the New York pilot boat, *Alexander M. Lawrence, No. 4*, when nearly twenty miles east of Nantucket, and making about thirteen knots, came into collision with a large whale. The shock was so great that the vessel careened until the water nearly reached the hatches. Those below immediately rushed on deck and looking aft, saw the whale rolling and tumbling about. Probably it was one of the large Rorquals.

About July 9th, Capt. John Winslow while out swordfishing, encountered a whale some nine miles southwest of Muskeget. The species is not mentioned, but it was presumably a Finback (Nantucket Journal, vol. 7, no. 41, July 9, 1885).

A dead whale was ashore at Nobadeer, Nantucket, about the first of September (Nantucket Journal, vol. 7, no. 49, Sept. 3, 1885). It was supposed to be the same one previously exhibited at Siasconset, and doubtless was one of the many Finbacks shot by the Provincetown whalers.

In the summer of this year a Finback was seen in Easton's Bay, R. I., by a number of people, including Mr. Philip Peckham, Jr., on whose authority Major E. A. Mearns reports the fact to me.

1886.— Whales were "numerous off the New England coast" in June of this year, and

a number were killed by three steamers engaged in their pursuit. These were Finbacks, in large part at least (W. A. Wilcox: Bull. U. S. Fish Comm., 1886, vol. 6, p. 201).

1887.— "Whales" are reported near Nantucket on two occasions, but no indication of the species is given. Three were reported by the Nantucket Lightship crew about April 15th, and shortly after a large whale was seen from Siasconset (Nantucket Inquirer and Mirror, vol. 67, no. 42, Apl. 16, 1887; Nantucket Journal, vol. 9, no. 29, Apl. 21, 1887).

1888.— "Whales" were sporting in the waters off Surfside, Nantucket, about April 20th, and although the Tuckernuck whalers came to attempt a capture, they were unsuccessful (Nantucket Journal, vol. 10, no. 30, Apl. 26, 1888). No indication of the species is given, but presumably they were Finbacks.

About June 5th, the steam whaler *A. B. Nickerson* fell in with a school of ten or more Finbacks off Cape Cod and killed a large one which sank at once after being shot (Nantucket Journal, vol. 10, no. 36, June 7, 1888).

1889.— The Nantucket Inquirer and Mirror of June 22d (vol. 69, no. 51) notes that "whales are reported numerous on the coast." No doubt this refers mainly to Finbacks.

About the 5th of August, a Finback was seen off Martha's Vineyard (Nantucket Journal, vol. 11, no. 44, Aug. 8, 1889).

1890.— About the last of April, a dead Finback was discovered floating near Egg Rock, by Swampscott fishermen, who towed it into Deer Cove, Lynn. It had been shot by a Provincetown whaler, and had sunk, to rise to the surface a few days later, much distended by gases (Nantucket Journal, vol. 12, no. 31, May 1, 1890).

1892.— About September 15th, a Finback Whale was seen spouting off Surfside, Nantucket (Nantucket Inquirer and Mirror, vol. 73, no. 12, Sept. 17, 1892).

1894.— A large Finback is reported killed off the "Gully" on September 12th by Capt. E. W. Smith of Provincetown (Boston Daily Globe, Apl. 3, 1895).

A small Finback was seen in the waters back of the Nantucket Harbor bar about the 20th of April. It may have been of this species (Nantucket Journal, vol. 16, no. 30, Apl. 26, 1894).

A school of Finbacks is reported off Cape Cod during late September. At least one or two were killed by whalers from Provincetown. The Nantucket Journal (vol. 16, no. 52, Oct. 4, 1894) notes that sharks had partially eaten one of those recovered.

1895.— The first Finback of the season was killed in Massachusetts Bay April 12th by Capt. E. W. Smith of Provincetown (Provincetown Beacon).

During a few days previous to May 10th, five were killed by the Provincetown whaler *A. B. Nickerson* in the neighboring waters, and two or three more were captured at the same time by other parties.

Under date of December 30th, Keeper McLaughlin writes that "for ten days a large school

of herring and whales has been off this station" (*i. e.* Southern Head, Grand Manan) (H. F. Moore: Rept. U. S. Comm. Fish. for 1896, 1898, p. 404). The whales were doubtless Finbacks.

1896.— A "good-sized school of whales," probably both Finbacks and Humpbacks, is reported about Cape Cod April 23d, following the herring school. At least two Finbacks were killed at this time by Provincetown whalers.

In the American Museum of Natural History at New York is the mounted skeleton of a Finback captured off Provincetown in April of this year. Figures of this specimen appear in the American Museum Journal (1907, vol. 7, pp. 94, 95).

A Finback drifted ashore at Nantasket Beach, Mass., on October 5th. It was about sixty-five feet long (Boston Journal, Oct. 5, 1896).

1897.— On June 2d, a Finback entered Narragansett Bay, and was seen by many residents of Newport and Jamestown, R. I. (Major E. A. Mearns).

1898.— On October 10th, or thereabouts, "a number of whales" probably Finbacks, were seen in the waters off Great Point, Nantucket (Nantucket Inquirer and Mirror, vol. 79, no. 16, Oct. 15, 1898).

1899.— About March 1st, several Finbacks were seen off Provincetown Harbor, and a fortnight later two large Finbacks entered the harbor itself, in pursuit of scattered schools of small herring. For an hour or two they rushed about in plain view of many fishermen, who, however, made no attempt to capture them (Nantucket Journal, vol. 21, no. 24, Mar. 16, 1899).

On March 11th, one came into Narragansett Bay, R. I., and was seen by the passengers on the tugboat *Monroe* (Major E. A. Mearns).

1900.— On August 28th, a Finback Whale came ashore at Point Judith, R. I. It was 51 feet long (H. M. Knowles in letter to Major E. A. Mearns).

1901.— A note in the Nantucket Inquirer and Mirror (vol. 81, no. 30, Jan. 20, 1901) reports that "whales and herring have appeared off Provincetown. The fishermen have caught many of the latter." These, no doubt, were Finbacks, an early school, following the fish.

About the middle of April, "a number of whales," probably Finbacks, were seen disporting themselves in the waters off Great Neck, Nantucket, and Tuckernuck. They remained two days, but no attempt was made to capture them (Nantucket Inquirer and Mirror, vol. 81, no. 42, Apl. 20, 1901).

1902.— Mr. M. C. Atwood, of Provincetown, while aboard the steamer *Cape Cod* on his way to Boston, saw a Finback come up so close to the vessel that he "could easily have jumped on to him." This was during the summer.

The Yarmouth Register, quoted by the Nantucket Inquirer and Mirror (vol. 83, no. 22, Nov. 29, 1902), reports the stranding of a large whale carcass on the beach at Sandwich in mid-November, and shortly after a second dead whale came ashore at Gloucester.

1904.— About June 20th, a "Finback Whale, about forty feet long, drifted ashore on the south side of Tuckernuck.... The body was badly blasted, and from its appearance it is thought to have been one of those with which schooner *Adelia T. Carleton* was in collision last week (Nantucket Inquirer and Mirror, vol. 84, no. 52, June 25, 1904). A later report from the same source (*ibid.*, vol. 85, no. 19, Nov. 5, 1904) states that since July, whales have been seen at various points along the eastern coast of New England.

1905.— About the first of February, a large school of Finback Whales was reported in Provincetown Bay, where they were said to be pursuing the large herring, then in those waters (Nantucket Inquirer and Mirror, vol. 85, no. 32, Feb. 4, 1905). This school was said to have been the largest seen in the Bay since 1880. How long the whales remained does not appear but a dispatch to the Boston Herald, from Provincetown, under date of March 17th, states that the men on the flatfish dredging fleet had seen a large school in Cape Cod Bay the two weeks previous. Captain Mayo of the dredger *Little Jennie* reports at least a dozen Finbacks blowing at the same moment, March 16th. "It is supposed they have come from off shore in pursuit of herring."

The highly decomposed carcass of what was probably one of this same school of Finbacks, came ashore at Old Orchard, Maine, June 8, 1905, and furnished the newspapers with material for a sensational account of the "Sea Serpent." A view of its skull is shown in one paper, and is apparently that of a Finback Whale.

A Finback Whale between fifty and sixty feet long was found ashore at Gay Head, Martha's Vineyard, about the 5th of August. The cause of its death was not known (Nantucket Inquirer and Mirror, vol. 86, no. 7, Aug. 12, 1905).

1906.— The following references to whales off the eastern coast of Massachusetts, probably apply to the Finback.

About the middle of June, the steamer *Admiral Sampson*, while running through a fog off Chatham, nearly ran upon a large whale as it rose to spout. As it dove its huge body was just grazed by the starboard side of the vessel and it almost at once came again to the surface and followed the vessel for some distance (Nantucket Inquirer and Mirror, vol. 86, no. 22, June 16, 1906).

From the same source comes the report of a whale that became entangled in one of the strings of thirty nets which stretched for nearly a mile out into Provincetown Bay from the bow of the mackerel drift-netter *Letha May*. During the night a whale blundered into the net, and became so enwrapped in the countless number of meshes that it was unable to rise to the surface for air and after a long struggle, died or became so exhausted that a fisherman who was tending the net succeeded in clearing the whale which sank at once (Nantucket Inquirer and Mirror, vol. 86, no. 23, June 23, 1906).

When off the Nantucket Shoals, about the 20th of August, the Atlantic Transport liner

Minnehaha passed through a large school of whales, many of which came very near the vessel (Nantucket Inquirer and Mirror, vol. 87, no. 8, Aug. 25, 1906).

1908.— About the 5th of July a sixty-foot whale, presumably a Finback, burst violently into the floating fish trap of a Provincetown fisherman and caused great havoc. The whale finally escaped (Nantucket Inquirer and Mirror, vol. 89, no. 2, July 11, 1908).

The Nantucket Inquirer and Mirror of September 5th, 1908 (vol. 89, no. 10) reports that whales had been seen occasionally to the south of the island during the few weeks preceding by the local fisherman. A dead whale was reported at this time as having been passed about five miles east-northeast of Nantucket by an Italian steamer bound for New York.

1909.— About the middle of July, a large school of whales was reported off Nantucket South Shoal Lightship, by the United Fruit Company's steamer *Esparta*, from Costa Rica. "The great school of whales stretched out as far as the eye could reach. The leviathans were heading north and were evidently in pursuit of mackerel. Some of them moved right along with the steamer for several miles. The officers of the steamer said they had never in their experience seen so many whales" (Nantucket Inquirer and Mirror, vol. 90, no. 3, July 17, 1909). If this report is to be credited there were evidently great numbers of whales in the school, "hundreds" according to the account, probably Finbacks in large part at least.

1910.— The steamer *St. Hugo* about the 7th of August, reported a school of whales some eighteen miles outside Highland Light, Cape Cod, according to Boston papers.

According to the Boston Journal of October 1st, 1910, two large whales had been observed in and about Eastport Harbor, Maine, for nearly a month preceding until during the last week of September their number was augmented to six. Probably they were Finbacks in part at least.

1912.— On January 17th, a Finback Whale was captured near Carlon's Island, three and a half miles from Eastport, Maine. It had entered a shallow channel to the north of Eastport, and on the fall of the tide was left stranded. Two Indians killed the whale and its oil was subsequently tried out. I am indebted to Mr. Roscoe C. Emery for particulars of this capture.

Dr. Henry B. Bigelow furnishes me a number of records of whales seen in the Gulf of Maine during a month's cruise for oceanographic investigation, namely:

July 15, two Finbacks at close range some ten miles southeast of Cape Ann, Mass.

July 16, one Finback about nine miles northeast-by-east of Halibut Point, Mass.

July 29, six large Finbacks were seen pursuing herring (which fishermen were also seining from boats) off Casco Bay, Maine, about ten miles south-by-east of Ragged Island.

Aug. 7, a Finback seen some five and a half miles southeast-by-south ½ south from the Cape Elizabeth whistling buoy; another was seen the same day on Platt's Bank off Cape Elizabeth, Maine.

Aug. 15, off Grand Manan, two large whales, apparently Finbacks, were seen; they were in pursuit of herring according to the fishermen.

On July 21st, while crossing Massachusetts Bay by steamer, Mr. George Nelson saw numbers of large whales, undoubtedly in part, at least, Finbacks. He estimated that near a hundred must have been sighted between Cape Cod and Boston. Some were close at hand, so that the high dorsal fin was clearly evident. The height of the spout he thought would average some ten feet. One came so close athwart the vessel's bow that her course was altered slightly to avoid a collision.

1913.— Whales, some undoubtedly Finbacks, appeared in numbers off Nantucket Lightship, where on May 19th, the Captain of the Norwegian steamer *Verona* reported to have run into a school of fifty or more, apparently working northward. There was said to have been a school of whales in Cape Cod Bay in early June, possibly some of the same lot.

In the last part of August of this year, Mr. W. W. Welch of the U. S. Bureau of Fisheries saw great numbers of Finbacks in the vicinity of South Shoal Lightship.

1914.— Mr. J. Henry Blake reports seeing one in July off Marblehead.

1915.— A school of ten Finbacks was seen close inshore from the High Head Coast Guard Station, near Provincetown, on July 19th. "One of the lot, a huge fellow, came in clear to the inner bar [Provincetown Harbor] and there exposed much of its body during the succeeding quarter hour" (Provincetown Advocate, July 22, 1915).

Seasonal Occurrence of Finback Whales.

(*n* indicates an indefinite number, or several.)

Locality	Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Off Monhegan Id., Maine	1614				*n*								
Maine Coast	1629						*n*						
Nantasket, Mass.	1719		1										
Swampscott, Mass.	1828					1							
Off Gloucester, Mass.	1833							1					
Off Whitehead Light, Maine	1833								1				
Massachusetts Bay	1833								3				
New Haven Harbor, Conn.	1834					1							
Off Gloucester, Mass.	1834						1						
Gloucester Harbor, Mass.	1834							1					
Portsmouth Harbor, N. H.	1836					1?							
Plymouth, Mass.	1842							2					
Provincetown Harbor, Mass.	1846												2
Outside Nantucket Harbor, Mass.	1854							1					
Provincetown Harbor and vicinity	1855											*n*	
Off Bird Id., Mass.	1856					1							
Off Highland Light, Cape Cod, Mass.	1856											*n*	
Provincetown Harbor, Mass.	1857				*n*								

Seasonal Occurrence of Finback Whales.— Continued.

Locality	Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Martha's Vineyard, Mass.	1858			1									
Off Point Judith, R. I.	1858										1?		
East of Grand Manan, N. B.	1859							*n*	*n*				
Smith's Point, Nantucket, Mass.	1861						1						
Off Nantucket, Mass.	1868										4		
Near Chatham, Mass.	1870				1								
Off Gloucester, Mass.	1870										1		
Nantucket, Mass.	1871										2		
Off Gloucester, Mass.	1871										1		
Point Shirley, Mass.	1871											1	
Provincetown Harbor, Mass.	1872												1
Wellfleet, Mass.	1872		1										
Off Block Id., R. I.	1873								*n*				
Vineyard Sound, Mass.	1874										*n*		
Smith's Id., near Tuckernuck, Mass.	1875								1				
Off Nantucket, Mass.	1876										2		
Off Nantucket, Mass.	1878							1					
Off Nantucket, Mass.	1878										?1		
Off Nantucket, Mass.	1879											1	
Provincetown Harbor, Mass.	1879									4			
Massachusetts Bay	1880			*n*	*n*	*n*	*n*						
Off Gloucester, Mass.	1880					*n*		1					
Off Nantucket, Mass.	1880			1			1						
Wakefield, R. I.	1880				1								
Massachusetts Bay	1880												1
Massachusetts Bay	1881					*n*	*n*						
Ipswich Bay, Mass.	1881								*n*				
Off Nantucket, Mass.	1881					1						*n*	
Off Gloucester, Mass.	1882					*n*							
Off Block Id., R. I.	1882						*n*						
Near Block Id., R. I.	1884							*n*					
Mass. Bay and Maine Coast	1885			*n*	*n*								
Mt. Desert, Maine	1885							1					
Off Plymouth, Mass.	1885							*n*					
20 miles east of Nantucket, Mass.	1885					1							
9 miles S. W. of Muskeget, Mass.	1885							1					
Nantucket, Mass.	1885									1			
New England Coast	1886						*n*						
Near Nantucket, Mass.	1887				?*n*								
Off Nantucket, Mass.	1888				*n*								
Off Cape Cod, Mass.	1888						10						
Massachusetts Coast	1889						*n*						
Off Martha's Vineyard, Mass.	1889								1				
Massachusetts Bay	1890				1								
Off Nantucket, Mass.	1892									1			

Seasonal Occurrence of Finback Whales.—Concluded.

Locality	Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Off Cape Cod, Mass.	1894									*n*			
Massachusetts Bay	1895				1								
Off Provincetown, Mass.	1895					*n*							
South of Grand Manan	1895												*n*
Off Cape Cod, Mass.	1896				*n*								
Off Provincetown, Mass.	1896				1								
Nantasket Beach, Mass.	1896										1		
Narragansett Bay, R. I.	1897						1						
Off Nantucket, Mass.	1898										*n*		
Narragansett Bay, R. I.	1899			1									
Off Provincetown Harbor, Mass.	1899			*n*									
Point Judith, R. I.	1900								1				
Off Provincetown, Mass.	1901	*n*											
Off Nantucket, Mass.	1901				*n*								
Sandwich, Mass.	1902											1	
Gloucester, Mass.	1902											1	
Tuckernuck, Mass.	1904						1						
New England Coast	1904							*n*	*n*				
Provincetown Bay, Mass.	1905		*n*	*n*									
Old Orchard, Maine	1905						1						
Gay Head, Mass.	1905								1				
Off Chatham, Mass.	1906						1						
Provincetown Bay	1906						1						
Off Nantucket Shoals	1906								*n*				
Provincetown, Mass.	1908							1					
South of Nantucket, Mass.	1908								*n*				
Nantucket South Shoal	1909							*n*					
Off Highland Light, Mass.	1910								*n*				
Eastport, Maine	1910									6			
Eastport, Maine	1912	1											
Off Cape Ann, Mass.	1912							2					
Off Halibut Point, Mass.	1912							1					
Off Casco Bay, Maine.	1912							6					
Off Cape Elizabeth, Maine.	1912								2				
Off Grand Manan	1912								2				
Cape Cod to Boston, Mass.	1912							*n*					
Off Nantucket Lightship	1913					*n*							
Cape Cod Bay	1913						*n*						
Off South Shoal Lightship, Mass.	1913								*n*				
Off Marblehead, Mass.	1914							1					
Off Provincetown, Mass.	1915							10					
Totals		1+ 1*n*	2+ 1*n*	3+ 4*n*	5+ 9*n*	6+ 6*n*	18+ 7*n*	30+ 5*n*	12+ 8*n*	12+ 2*n*	13+ 2*n*	4+ 3*n*	4+ 1*n*

It at once appears from a consideration of this table that Finback Whales are most commonly met with off the eastern coasts of New England between April and October, both inclusive; are less common in March and November and December; while in January and February they are rarely seen. These facts indicate that during the colder months Finback Whales leave our shores in some degree, but there can be little doubt that temperature, although a determining cause, is of indirect influence only to the extent that it affects the distribution or abundance of the organisms on which the whales subsist. The deposit of fat or blubber which encases the whale must act to protect the animal from discomfort through changes of water temperatures of moderate degree, but where this deposit is very thin as inside the mouth, the cooler temperature of the water must tend somewhat to lower that of the body. Yet Finbacks are common during summer in the Arctic seas where the waters are much colder than off our Massachusetts coast at the same season, which shows that they can accommodate themselves to a moderate range of temperature.

That it is the presence or absence of food which governs the appearance of these whales, and notably the season of abundance of herring in our waters, will I think, be apparent from further analysis of these records.

The habits of the herring have been briefly mentioned under the heading of Food. As there stated, they seem to seek deep water during the winter, although occasional catches are made at that season; but in early spring they approach the shores, so that in Passamaquoddy Bay, where their appearance has been carefully studied, the fish weirs are tended regularly from the first of April to the end of the year, the times when whales are most often observed. The greatest abundance of herring is in July and August which closely corresponds with the time when the whales are most numerous. At this time great shoals of young herring, the progeny of the previous autumnal spawning, appear on the New England coast, and remain until the winter, at intervals coming in enormous quantities. The larger fish are spawning in fall from about the last of September through October and approach the shores for that purpose. After October they disappear more or less, though usually scattered schools may be found in favorable localities during December. Their appearance during the winter months seems to be irregular and uncertain, but occasionally large numbers do come, and with them the whales. Thus of the two January records given, the first relates to a 1901 report that "whales and herring have appeared off Provincetown. The fishermen have caught many of the latter." The second is of one killed near Eastport, Maine, that had a large herring entrapped in the baleen, showing that it had been in pursuit of those fish. Of the three February records, two relate to whales washed ashore dead, while the other is of a school that appeared in Provincetown Bay, about the first of that month, 1905, and were said to be pursuing the large herring then in those waters. Of the March records where details are given, the same is true. Thus in 1880, large numbers came into Provincetown Bay early in March, in pursuit of

"immense quantities of herring and shrimps"; and in 1899, several Finbacks about March 1st were seen in the same waters "in pursuit of scattered schools of small herring." In late April, 1896, a "good-sized school of whales" is reported about Cape Cod following the herring school. In 1880, the school of whales remained much of the summer in the Gulf of Maine and were also reported to be feeding on sand eels (Ammodytes) which appeared in June in abundance. Again, in late December, 1895, "a large school of herring and whales" is reported in the Gulf of Maine, off Southern Head Station, Grand Manan.

During the summer months the Finbacks are also feeding largely on small crustaceans, on our coasts, and the herring likewise pursue these. Their presence is therefore an additional factor in attracting the whales. In calm weather these crustaceans appear in vast swarms, tinging the sea with red at times. When the surface of the sea is much ruffled they seek the quieter waters at moderate depths, and apparently are much less evident in the winter months. It is plain that they must be gathered in larger masses when they seek the surface than when they retire to the depths since in the former case their further upward progress is checked by a common barrier. The whales probably find it much easier to engulf them in quantity when thus assembled near the surface, and it seems unlikely that they could successfully pursue them at any but the most superficial depths. Direct evidence is wanting that the Finbacks feed on these shrimps in winter on our coasts, though it may well be that the latter appear during favorable weather.

To conclude, it seems probable that this whale is largely regulated in its appearance on our coast by the time when the herring schools are present, particularly during the winter months; while the abundance of the small shrimps and copepods in summer together with the herring accounts for the greater abundance of the cetaceans during the summer and fall. The herring in turn are probably dependent in some degree upon the copepods and other small crustaceans which abound during the warm months in the shallower onshore waters. Whether they both retire in inclement seasons to deeper water beyond the feeding range of the whales is unproven, but seems probable.

Finback Whaling on the New England Coast.

While our forefathers vigorously pursued the Right Whale on the New England coasts during the seventeenth and eighteenth centuries, they seldom molested the swifter moving Finback and Sulphurbottom Whales. This was in part because these yielded only a small return of oil and whalebone in comparison with the Right Whale, but chiefly because they were unable to kill them with hand harpoons from an open boat except by some lucky chance. For so swift and strong are these leviathans that unless at once lanced in a vital part, it is almost impossible to tire them out or work the boat up again within striking distance.

That intrepid mariner, Captain John Smith, seems to have been the first to attempt the capture of this species of whale in New England waters. His efforts were confined to the Maine coast about Monhegan Island. But he met with no success, as his cheerful narrative sets forth. "In the month of April, 1614," he writes,[1] "with two ships from London, of a few merchants, I chanced to arrive in New-England, a part of America, at the isle of Monahiggan, in forty-three and a half of northerly latitude. Our plot was there to take whales, and make trials of a mine of gold and copper. If those failed, fish and furs was then our refuge, to make ourselves savers howsoever. We found this whale-fishing a costly conclusion. We saw many, and spent much time in chasing them; but could not kill any, they being a kind of jubartes, and not the whale that yields fins and oil, as we expected." Evidently the Right Whales had mostly gone to the north, and the Finbacks only were met with, to the great discomfiture of the resourceful captain and his men who none the less, did make themselves "savers" through trading for furs with the Indians.

The early whalers of Massachusetts Bay and Cape Cod were well acquainted with the Finback, but generally made no attempt to capture it. Paul Dudley, in his essay on the New England whales (1734, p. 425), writes that it is somewhat longer than the Right Whale "but not so bulky, much swifter, and very furious when struck, and very difficultly held; their Oil is not near so much as that of the Right Whale, and the Bone of little Profit, being short and knobby." Similarly, Hector St. John Crèvecoeur, who visited Nantucket at about the period of the Revolution, writes in his Letters from an American Farmer (1782), that the Finback and Sulphurbottom, though familiar to the Nantucket whalers, were never or seldom killed by them, "as being extremely swift," and "the grampus, [*Balaenoptera acuto-rostrata?*] thirty feet long, never killed on the same account."[2] Nevertheless the sight of such great whales close at hand must often have tempted the hardy whalemen to make hazard with harpoon or lance or even with the musket, if perchance they might capture these swifter species. So, in the Boston News Letter, of September 3d, 1722, is advertised a court of admiralty to be held at Boston on the last Wednesday in the month, to adjudicate on a 'drift-whale' found floating near the Brewsters, and towed ashore in August. It was much wasted and decayed, and on cutting it up a musket ball was found in the carcass, that had doubtless been fired into it and had caused its death. The advertisement notifies the public that "if any Persons can try any Claim to said Whale so as to make out a Property," they shall appear duly at the said court. From the fact that the whale was killed in August it is probable that it was a Balaenoptera. Doubtless some of the 'drift whales' mentioned in the earlier records were Finbacks,

[1] Smith, Capt. John. A Description of New England, London, 1616; reprint in Coll. Mass. Hist. Soc., 1837, ser. 3, vol. 6, p. 103.

[2] J. Hector St. John Crèvecoeur. Letters from an American Farmer, London, 1782. Reprint, New York, 1901, see p. 175.

that had escaped, mortally wounded, to die and later wash ashore. Thus Weeden [1] notes that "drift whales appear in the Boston newspapers,— a finback at Nantasket in 1719 [Boston Gazette, Feb. 28th] and again in 1720 [Boston News Letter, Feb. 15th]; at Marblehead in 1723 [Boston News Letter, Aug. 22d]; and a flotsam 'between the Capes' with a harpoon 'in her' in 1725 [Boston News Letter, July 15th]. Always in the feminine, these valuable strays are brought into the Admiralty Court with every formality of advertisement to secure justice to possible claimants."

Since the days of Captain John Smith, 1614, no systematic attempt to capture Fin Whales on the coast of New England appears to have been made until about 1810, when according to R. E. Earll,[2] a shore-fishery was begun and successfully prosecuted for a number of years, from Prospect Harbor, in Frenchman's Bay, Maine. This industry was undertaken by Stephen Clark and L. Hiller, of Rochester, Mass., who "came to the region, and built try-works on the shore, having their lookout station on the top of an adjoining hill. The whales usually followed the menhaden to the shore, arriving about the 1st of June, and remaining till September.... Ten years later they began using small vessels in the fishery, and by this means were enabled to go farther from land. The fishery was at its height between 1835 and 1840 when an average of six or seven whales were taken yearly.... The business was discontinued about 1860, since which date but one or two whales have been taken." It is probable that Humpback Whales constituted the chief part of the catch, if indeed any others were taken at all. Clark [3] further informs us that "shore-whaling in the vicinity of Tremont, [Maine] began about 1840. Mr. Benjamin Beaver and a small crew of men caught three or more whales annually for about twenty years, but gave up the business in 1860. No more whales were taken from this time till the spring of 1880, when one was taken and brought into Bass Harbor, and yielded 1,200 gallons of oil but no bone of value.

"Capt. J. Bickford, a native of Winter Harbor, is reported by Mr. C. P. Guptil to have cruised off the coast in 1845 in schooner *Huzza*, and to have captured eight whales, one of which was a finback, the rest humpback whales. This schooner made only one season's work, but in 1870 Captain Bickford again tried his luck in a vessel from Prospect Harbor and captured one finback whale." Of the method of whaling as employed by these men, we have no record, but doubtless they attacked the whales from their whaleboats, and after making fast with the harpoon endeavored at once to reach a vital spot with the lance. If this were not accomplished the whale stood a good chance of escape. Such an adventure is illustrated by an anecdote reported in the Nantucket Inquirer for December 14, 1846 (vol. 26, no. 142). "On

[1] Weeden, W. B. · Economic and Social History of New England, 1890, vol. 1, p. 439.

[2] Earll, R. E. The Coast of Maine and its Fisheries. In Goode's Fisheries and Fishery Industries of the U. S., 1887, sect. 2, p. 30.

[3] Clark, A. Howard. The Whale Fishery. In Goode's Fisheries and Fishery Industries of the U. S., 1887, sect. 5, vol. 2, p. 40.

Monday morning two large Finbacks were seen playing side by side in Provincetown harbor, whereupon Capt. Cook of the bark Fairy, and Capt. Soper, late of the brig St. Thomas, manned two boats and pounced upon the leviathans.... Capt. Cook gave his customer a harpoon and a lance as quick as he could dart, and turned him up in about fifteen minutes. Capt. Soper also fastened to the other, but so far aft as not to affect the vitals, in consequence of which he could not get alongside to lance him. The whale ran his boat to Truro, and after cutting down the chocks of the boat and making her leak, the line was cut and the whale went away with the harpoon and about 50 fathoms of line."

Such, therefore, was the uncertain and desultory manner in which the capture of the Finback Whale was attempted on our coast previous to 1850. At about this time, however, came the introduction of the whaling gun and the deadly bomb-lance, whose effectiveness caused a short-lived revival of this industry here, with the Finback and Humpback as the special objects of pursuit. About 1847, C. C. Brand, of Norwich, Connecticut, invented a harpoon gun weighing from eighteen to twenty-three pounds, to be fired from the shoulder. The Nantucket Inquirer, in that year mentions this weapon as a great innovation: "We saw yesterday at the store of Captain E. W. Gardner a very curious contrivance for killing whales. It is a short gun weighing some twenty-five pounds — the stock being of solid brass — from which a harpoon is to be fired into the animal. The handle of the harpoon goes into the gun about a foot, and a line is fastened to it, of course outside the gun, by which the whale is to be held. There is also a bomb lance for the purpose of killing the animal. The instrument is loaded with powder, and a slow match is led from the magazine to the end which goes into the gun. When the lance is fired into the whale the slow match ignites; and in about half a minute the fire reaches the powder which is in the head of the instrument, which instantly explodes, killing the animal outright. At least, that is what the article is intended to do. The whole apparatus is certainly very ingenious; whether or not it is really an improvement on the present mode of killing whales is more than we are able to say. That is a question that must be settled by the whalemen themselves."

At about this time also, one Robert Allen, likewise of Norwich, Connecticut, invented a bomb-lance to be fired from a shoulder gun. It was a long metal tube filled with powder, which was exploded by means of a time fuse. This proved ineffective as well as dangerous, because it lacked feathering of any sort to make it travel end on. This defect, however, was overcome by Brand, who in 1852, devised feathers of rubber, which were attached at the proximal end and folded up when the lance was thrust into the gun.[1] This bomb-lance was simply shot into the whale, and no line was attached, so that if not immediately fatal the whale made off, and might or might not be recovered. In case of the Finback Whale,

[1] Spears, J. R. The Story of the New England Whalers, New York, 1908, p. 220.

which usually sinks at once on being killed, the carcass might not appear for two or three days until buoyed to the surface by the accumulated gases of decomposition. This style of bomb-lance met with great favor among the Cape Cod whalers and later was much used in shore whaling.

In early July, 1854, the schooner *William P. Dolliver* sailed from Nantucket for a short whaling cruise on the Shoals. When a little distance outside Nantucket bar, the whalers saw a large Finback so close at hand that the bomb-lance was shot into it from the schooner's deck, killing the animal at once. It sank in seven fathoms of water, but was raised with grapplings procured from the shore, and later towed with the schooner back to the harbor by the steamer *Massachusetts*. It was thought that the blubber would yield sixty or seventy barrels of oil, worth in the neighborhood of a thousand dollars.[1] This would indicate a large whale, or a large estimate. The incident is further of interest as indicating that at this time the pursuit of whales, probably Humpbacks and Finbacks, was undertaken in a small way on the Shoals, and was probably made much more profitable through the introduction of the whaling gun with its explosive lance.

The Nantucket Inquirer of November 21st, 1855 (vol. 37, no. 137) notes that several Finbacks had of late been seen in Provincetown Harbor, and that on the 17th of that month a single one had appeared, and immediately became an object of pursuit by some fifteen boats, hastily manned. "About thirty minutes after he was first seen, he was struck by a harpoon from one of the boats, when he immediately commenced running, dragging the boat and nearly filling it with water, but in some manner he cleared himself." Evidently, from this account, the use of the bomb-lance had not yet become universal.

Two years later, we learn from the same source[2] that about the middle of April, 1857, "there was fine sport in Provincetown on Monday last with boats pursuing Finback Whales. Two of them were harpooned, but the rapid movement of this species of whale, does not suffer them to be taken in this way. They are now taken with a bomb-lance, or a lance which is fitted with a charge of powder, to explode after it enters the whale." A similar incident is related in December, 1872, when a Finback appeared in Provincetown Harbor, and was harpooned by Captain Isaac Fisher. Although it received three lance thrusts, it finally parted the line and escaped.[3] Again in late October, 1868, a boat's crew put off from Nantucket in pursuit of four Finbacks, seen in the bay, but after following them for some miles to the westward, was obliged to relinquish the chase.[4] In the latter half of October, 1874, "large schools of whales," probably Finbacks for the most part, were seen in Vineyard Sound, and from

[1] Nantucket Inquirer, vol. 34, no. 80, July 7, 1854.
[2] Nantucket Inquirer, vol. 30, no. 41, Apl. 20, 1857.
[3] Nantucket Inquirer and Mirror, vol. 53, no. 24, Dec. 14, 1872.
[4] Nantucket Inquirer and Mirror, vol. 49, no. 18, Oct. 31, 1868.

Noman's Land, Gay Head, and Cuttyhunk. "Several first-class whalemen took a whaleboat, with tow lines, harpoons, lances, bomb guns," and went in pursuit. Off Canapitset, a whale, said to have been a Sulphurbottom, was shot with a bomb-lance, but immediately sank. A Finback was shot near Cuttyhunk, but also sank. It was said that four in all were shot with bomb-lances, but none was recovered (Forest and Stream, vol. 3, p. 188, Oct. 29, 1874). But the Nantucketers were now passing to other pursuits, and when in 1876, a Finback was reported near their shore, the Inquirer [1] bemoaned the fact that there was "not a whale boat and gear with which to pursue."

On the North Shore, some fishermen in late October, 1870, captured a Finback about ten miles off Gloucester, and towed it to Boston for exhibition. The oil which it finally yielded was said to have been but six barrels.[2]

The year 1880 marks the revival of shore whaling in Massachusetts waters, and for some fifteen years thereafter much profit was had from the capture of Finbacks and Humpbacks. Most of the whaling was carried on from Provincetown, and the weapon used was generally the bomb-lance fired from a shoulder gun.

A. Howard Clark [3] relates that "early in March, 1880, there came into Provincetown Bay and harbor immense quantities of herring and shrimps. They were followed by a great number of Finback Whales, which were here most of the time in greater or less numbers until about the middle of May, when they all left. During the time they were here many of them were killed with bomb lances. They sank when killed and remained at the bottom some two or three days. They then came up to the top of the water, and as they were liable to come up in the night or during rugged weather, when the whalemen were not there to take them, many of them drifted out to sea and were lost. Thirty-eight were brought in and landed at Jonathan Cook's oil works on Long Point. The blubber was taken off and the oil extracted from it in the above-named factory. Two others brought in were sold to parties who took one of them to Boston and the other to New York, where they were exhibited, making forty whales in all saved. Early in June immense quantities of sand eels (*Ammodytes*) came in our harbor [Provincetown] and bay and remained here several days. About the 10th of June there appeared plenty of whales, feeding on the sand eels. They were again attacked by our men, when a number of them were killed in a few days, of which ten were saved and landed at the oil works. Probably as many more that were not killed outright received their death wounds and went out of the bay and soon after died and were lost. The forty-eight whales delivered at the oil works yielded 950 barrels of oil, sold at an average price of 40 cents per gallon."

[1] Nantucket Inquirer and Mirror, vol. 57, no. 17, Oct. 21, 1876.
[2] Nantucket Inquirer and Mirror, vol. 51, no. 20, Nov. 12, 1870.
[3] Clark, A. Howard: in Goode's Fisheries and Fishery Industries of U. S., 1887, sect. 2, p. 230.

The proceeds of these 48 whales were:

29,925 gallons of oil at 40 cents	$11,970.00
8,750 lbs. whalebone from 35 whales at 15 cents	1,312.50
one whale sold for exhibit at Boston	350.00
one whale sold for exhibit at New York	405.00
	$14,037.50

A report[1] from Gloucester, Massachusetts, under date of May 13, 1880, refers again to the numbers of whales in the near shore waters at this time. Four dead ones had been towed into the harbor that had doubtless been shot and lost by the Provincetown fishermen. Three were towed into Boston, one to Newburyport, one to Cape Porpoise, one to Portland, one to Mt. Desert; two drifted ashore at Scituate, two at Barnstable, one at Brewster, one at Orleans, two at Wellfleet, one on the back of Cape Cod, and one was stripped of its blubber at sea (A. Howard Clark, 1887).

"When the first whales were killed it was supposed the whalebone in their mouths was worthless. It was not saved. Subsequently some was saved and sold at 15 cents per pound. The average quantity of bone in each whale is about 250 pounds.....

"In the spring of 1881 the whales came into the bay again, but not in so large numbers. Fifteen were killed which furnished 300 barrels of oil....No whales have come in of late."

In a letter from Mr. J. Henry Blake, dated September 8, 1881, accompanying some bones of a foetal Finback in the Museum of Comparative Zoölogy, he states that fifty-one whales were killed that spring by the Provincetown whalers. The female from which the foetus was taken, was about sixty-five feet long, very fat, and yielded thirty-two barrels of oil, an unusual amount.

It will be seen that the average yield of oil per whale from these Finbacks was in both lots, almost exactly 20 barrels.

The annals of whaling at Provincetown indicate a lull in the industry for about four years succeeding 1881. In 1885, however, Finbacks appeared in numbers on the coast, and in this and the following year, many were captured. A report[2] from Gloucester, Mass., under date of March 8, 1885, says that the fishermen had "never seen whales so numerous on the eastern shore as at present. The steamer *Fannie Sprague*, of Booth Bay, formerly used in the porgy fishery, which has been fitted out as a whaler, shot six whales last week. Two of them were safely towed to Booth Bay, but the other four, which sunk, are buoyed." The success of the *Fannie Sprague* and the abundance of whales this year, encouraged others to venture in their pursuit. Accordingly we learn that "during the past two months [March and (?) April, 1885] four steamers have been engaged in this work, viz. *Fannie Sprague, Mabel Bird, Hurricane*,

[1] Clark, A. Howard. Bull. U. S. Fish Comm., 1884, vol. 4, p. 404.
[2] Martin, S. J. Bull. U. S. Fish Comm., 1885, vol. 5, p. 207.

and *Josephine*. They cruise off the Maine and Massachusetts shores as far south as Cape Cod. A bomb-lance, fired from a gun held at the shoulder, is used for killing the whales. Up to date about 40 whales have been captured. As the men become expert in the manner of capture, the whales become shy and keep more in deep water. After being killed they usually sink, and it is doubtful if the business, as at present conducted, will last if the whales are driven off from near shore, it being difficult to recover them in over 40 fathoms of water. The whales captured the past few weeks average 60 feet long and weigh about 25 tons each; they yield about 20 barrels of oil, 2 barrels of meat, 5 tons of dry chum, and 2 tons of bone, about $400 being realized from each whale, on the average." [1] The steamer *Fannie Sprague* was a Booth Bay vessel, but the home port of the three others is not given.

Another report [1] states that five small steamers in all were engaged in the Finback shore fishery in the Gulf of Maine during 1885. The fleet landed part of the whales at Provincetown, Massachusetts, and the remainder at the factories in Maine. Capt. Joshua Nickerson of Provincetown was thus engaged at this time and on July 7th, as Mr. J. Henry Blake tells me, shot a Finback in Massachusetts Bay making about the thirty-eighth he had caught. A few days before, July 3d, a male Finback had drifted ashore at the Mt. Desert Light Station, Maine,[2] that had probably been shot by one of these whaling steamers. Earll states [3] that about seventy-five whales were captured by the combined efforts of these five steamers in 1885.

In the following year these whales continued to be numerous offshore, and a report [4] under date of June, 1886, states that "three steamers are engaged in taking them, being quite successful, although many that are shot and sink in deep water are not recovered." One of these three vessels was the *A. B. Nickerson*, commanded by Captain "Josh" Nickerson, of Provincetown, but the names of the two others though not given may be surmised as of those previously engaged. In this same year, according to Jennings [5] an oil works was set up near Race Point Light, Provincetown, and in 1887 a bone crusher was added for reducing the skeletons of the whales to lime. Of the whaling in 1886, I have found no definite record, but it seems to have been less productive than in 1885, and nothing further is heard of the Maine steamers. Captain Nickerson, however, continued to pursue whales in the home waters during the next ten years with much success.

The following brief review of Captain Nickerson's campaign is based mainly on notes and clippings kindly furnished me by Mr. J. Henry Blake, as well as on reports in the Nantucket Inquirer and Journal. From the last-named source [6] it appears that in early June, 1888, the

[1] Wilcox, W. A. Bull. U. S. Fish Comm., 1885, vol. 5, p. 169.
[2] Smiley, C. W. Bull. U. S. Fish Comm., 1885, vol. 5, p. 337.
[3] Earll, R. E. Bull. U. S. Fish Comm., 1886, vol. 6, p. 312.
[4] Wilcox, W. A. Bull. U. S. Fish Comm., 1886, vol. 6, p. 201.
[5] Jennings, H. A. Provincetown or, odds and ends from the tip end, 1890, p. 136.
[6] Nantucket Journal, vol. 10, no. 36, June 7, 1888.

A. B. Nickerson fell in with a school of about ten Finbacks off Cape Cod, and succeeded in killing a large one which sank at once. In the following year a Finback Whale that had been shot about the first of May (1890), was found floating near Egg Rock, Swampscott, and was towed into Deer Cove, Lynn. These reports are doubtless but an echo of the activity of the little steam-whaler, for Mr. Blake, in response to my inquiries, sends me a note from Mr. M. C. Atwood, of Provincetown, in which he says, "John Rosenthal told me that the highest number of whales that the steamer killed in any one year was fifty-two and other people killed about the same number during the same year, which is quite a slaughter. That was in 1887, he thinks. I remember the year well. At one time Job Cook had at his place on Long Point, fourteen whales. But they are gone now [1903] and it is a rare thing to see one."

The Nantucket Journal for October 4, 1894, makes mention of a school of whales about the Cape at that time, at least one of which was killed. In the previous month, September 12, 1894, Captain "Ed. Walter" Smith of Provincetown, had killed a large Finback off the "Gully."[1] But the following year seems to have yielded a greater harvest. A clipping from the Provincetown Beacon in early May, 1895, states that on April 12th, of that year, the first Finback of the season was shot by Captain E. W. Smith and eighteen days later a "young whale" was killed by the Truro trapmen. Captain Fuller in the *Vigilant*, next killed one which was sold to Boston parties for embalming and exhibition. Captain Nickerson in the *Angelina B. Nickerson* killed five about the first week of May. The same week Captain Joshua Nickerson shot a "very large whale", Captain Fuller and Captain "Ves" Ellis each shot one — all Finbacks. Eleven whales in all was thus the total catch up to about the 10th of May of 1895. The Nantucket Journal[2] also refers to the large Finback caught by Captain Nickerson, and adds that between April 12th and May 16th, he had captured and towed to his oilworks at Herring Cove, Provincetown, no less than eight whales.

The season of 1896 was likewise a prosperous one for the local whalers. A clipping dated Provincetown, April 23, 1896, reads: "Steamer *A. B. Nickerson*, Captain Nickerson, has killed four whales, two of which were Humpbacks, and has landed them at the oilworks in Herring Cove....A good-sized school of whales is reported around the Cape, following up the herring school, and the fleet of small steamers here is on the warpath after them." Other whales were undoubtedly taken during the remainder of the summer, but how many does not appear. According to the Boston Journal for October 5, 1896, a Finback, sixty-five feet in length, drifted ashore at Nantasket Beach, and had probably been shot by the whalers shortly before.

The year 1896 practically closes the Finback whaling in our waters, and the *A. B. Nickerson* has gone in search of other quarry. The tryworks have fallen into disuse and though

[1] Boston Daily Globe, Apl. 3, 1895.
[2] Nantucket Journal, vol. 17, no. 33, May 16, 1895.

an occasional whale still appears from time to time in the harbor at Provincetown, there is rarely any special attempt made to capture the visitor. For the oil commands but a small price and the whale guns and bomb-lances are laid on the shelf. The occasional dead whale that now drifts ashore is looked upon rather as a common nuisance than as a prize, and the local Boards of Health rather than the whalemen see to its disposal.

Commercial Value.

From the facts given in the preceding pages it appears that the average production of forty-six Finbacks killed in our waters in 1885 was about 650.5 gallons (20+ barrels) of oil apiece valued at that time at $260.20. Thirty-five whales produced 250 pounds of whalebone apiece on an average, which at 15 cents a pound, made the yield per whale worth $37.50. The total value of each whale was therefore $297.70, or nearly three hundred dollars.

A yield of twenty barrels of oil per whale is perhaps a high average. Atwood mentions fourteen and twenty barrels respectively from two Finbacks. From one large and very fat cow whale, 65 feet long, thirty-two barrels of oil were made, an unusual amount.

The oil from whales of this genus and of the Humpback differs from that of the Sperm Whale in its high percentage of glycerine, 6 to 10 percent on an average, or even as much as 14 percent. According to the 1915 report of the New York Chamber of Commerce, the demand for glycerine for the manufacture of explosives has given great impetus to this branch of the whaling industry, particularly in Pacific waters. Most of the oil goes to the English market, and the price has risen from 35 cents a gallon in 1913 to 55 cents in 1915.

The baleen of the Finback is, next to that of the Pollack Whale, the best in quality excepting, of course, that produced by the Arctic Bowhead and the Right Whale. Its manufacture into strips of various sizes and qualities is described by Stevenson (1907).

A much greater return than a bare $300 per whale could be had with proper facilities for using the entire carcass. The shore-whaling industry as developed on the Norwegian and Newfoundland coasts of late years has succeeded in utilizing every part of the huge animal, and at the Newfoundland stations I was told in 1903 that a Finback Whale of average size was valued at about a thousand dollars. The fishery there began actively in 1897, and several stations quickly sprang up. These stations consist of a slip on which the whale is drawn from the water by powerful steam winches, a house for the tryworks, another for the machinery used in converting the flesh into fertilizer, a bone crusher, and houses for the workmen. The blubber is cut off in strips by men using long blades set in the ends of poles. These with the tongue are cut in small pieces, thrown into a hopper where they are further minced, and conveyed by an endless chain of buckets to the vat where the oil is tried out and dipped off into barrels. From part of the residue a glue is made. The carcass, after being stripped of its layer of blubber,

is reduced to large chunks, which are tried out in open wooden vats in which are coils of steam piping to supply heat. The oil dipped off from these vats is of a poorer grade and needs first to be bleached by chemicals before it is ready for market. The boiling process separates the flesh from the bones, and the latter are crushed to be used as lime fertilizer. The meat fragments are passed through a long revolving drum in which they are greatly comminuted by swinging knives inside the drum, while at the same time the bits are dried by heat. The result is a coarse powdery material which, when moistened, makes excellent fertilizer. It is also used in Scandinavia for feeding cattle. The plates of whalebone are separated from their attachment to the fibrous mass of the roof of the mouth, are then washed and dried in the sun, sorted and packed into bales for transport. Thus the greater part of the whale is utilized, and the actual waste very small. The Newfoundland companies have, through Dr. L. Rissmuller, developed sundry chemical processes for reducing and saving various parts. The success of one or two companies in the early years of this fishery soon led to the erection of numerous stations on the Newfoundland shores, and the inevitable depletion of the whales resulted disastrously for many of those whose capital was involved. In 1914 the report of the Newfoundland whaling industry showed a marked decline. Of the six ships engaged in the home waters that year only one paid dividends. It secured 65 whales out of a total of 168. Contrast this with the yearly average of 1500 whales for the first years succeeding 1897 when the industry was started!

The varying abundance of the whales from season to season, and the chances of the sea are factors to be reckoned with in such enterprises, yet it would seem that if a factory were erected on Cape Cod or Nantucket, for the rendering of whales into oil, lime, and fertilizer there might be a fair chance of a reasonable income. It has even been proposed, on the Pacific coast, to can the meat for ordinary consumption. Those who had tried whale meat at Newfoundland, pronounced it very good, somewhat coarser than beef, but otherwise hardly inferior. In Japan it is a staple article of diet. It should be added, that in the modern method of whaling, small steamers are used, and that instead of bomb-lances being shot into the whale with the hope that the dead animal might subsequently be found, a large harpoon, weighing over one hundred pounds, and provided with an explosive cap is used. This harpoon carries a strong four-inch manila cable so that it is seldom a whale is lost, and if its first efforts at flight do not exhaust it, this line can be warped in until the whale is near enough for a second shot, or it may be lanced from an open boat rowed alongside.

On the Labrador coast at the present day the long jaw bones of Fin Whales are used to shoe the wooden runners of the dog-sledges for winter travel. They are allowed to soak in the seawater for a considerable time, which is said to harden the texture of the bone. Strips are then sawed from them half an inch thick and the width of the runner, to which they are attached by pegs of wood. The advantage of this sort of runner is that the snow does not stick to it.

Enemies and Parasites.

In our waters, the larger whales seem to have little to fear from other predatory creatures. No doubt the fierce Orca or Killer Whale may occasionally attack them but I have no definite evidence on this matter, and the species is rare with us.

Ordinarily the Finback Whale does not harbor any barnacles on the body surfaces, though the whalemen tell me that rarely a small species resembling a common ship's barnacle is found on captured specimens.

On the plates of whalebone Lillie (1910, p. 786) has lately recorded for the first time in this species, the presence of multitudes of the minute crustacean *Balaenophilus unisetus* Aurivillius, a copepod modified for this semiparasitic existence. These minute animals reach an adult size of less than four millimeters and in both young and mature stages are found clinging in multitudes to the baleen plates. Lillie's observations were made on the Irish coast, but the same parasite is to be looked for on this side of the water.

Another copepod, *Penella balaenopterae*, likewise occurs as a parasite of this whale, and is most remarkably modified for life with its huge host. In the earlier stages, both sexes are of more or less normal appearance, with enlarged thorax, narrower abdomen, and swimming appendages. The adult female, however, burrows with her head deeply into the exterior of the whale, and her entire body becomes transformed into an elongated sac, the head develops horn-like anchors for holding, and the remainder of the body with two long egg sacs and gills trails behind in the water, some eight inches in length. Turner (1905) mentions finding numerous specimens in the back of one of these whales.

Of internal parasites the best known are certain so-called thorn-headed worms of the genus Echinorhynchus, which attach themselves to the lining of the intestine. The sexes are separate, and the larvae pass from the body of the female worm into the intestinal cavity of the whale, whence they are discharged with the faeces. In many other species these young pass the next stage of life as parasites in Crustacea, so it is likely that in some one or other of the minute copepods or schizopods on which these whales feed, this second stage will be found. The crustacean host is swallowed in its turn by the whale, and so allows the parasite to pass its adult stage in the whale's intestine. Borgström (1892) was the first to report *Echinorhynchus turbinella* from the Common Finback, and it occurs also in the Pollack Whale. A second species, *E. brevicollis*, is lately reported from the intestine of the Finback (Hamilton, 1916, p. 132).

Haldane records finding two or three bushels of nematode worms in the stomach of a Finback, which were identified by Von Listow as *Ascaris simplex*, a species that also occurs in the Harbor Porpoise. In the intestines of Fin Whales killed from the Belmullet Whaling Station on the Irish coast, Hamilton (1915, 1916) has lately reported finding numbers of the trematode, *Monostomum plicatum*.

Balaenoptera borealis Lesson.

Rudolphi's Rorqual; Pollack Whale.

Plate 13, Fig. 1.

Synonymy.

1822. *Balaena rostrata* Rudolphi, Abhandl. K. Akad. Wiss. Berlin, for 1820-21, p. 27–40, pl. 1–5 (not of Müller, 1776; not of Fabricius, 1780).
1828. *Balaenoptera borealis* Lesson, Hist. Nat. Gén. et Partic. des Mamm. et des Oiseaux, Cétacés, p. 342, pl. 12.
1829. *Balaena borealis* Fischer, Synopsis Mammalium, p. 524 (in part).
1846. *Balaenoptera laticeps* Gray, Zool. Voyage Erebus and Terror, Mammalia, p. 20.
1847. *Balaena physalus* Nilsson, Skandinavisk Fauna, pt. 1, p. 636 (in part).
1864. *Sibbaldus laticeps* Gray, Proc. Zool. Soc. London, 1864, p. 223.
1864. *Sibbaldius laticeps* Flower, Proc. Zool. Soc. London, 1864, p. 393.
1864. *Physalus laticeps* Flower, Proc. Zool. Soc. London, 1864, p. 395.
1868. *Rudolphius laticeps* Gray, Synopsis of Species of Whales and Dolphins British Museum, p. 3; Suppl. Cat. Seals and Whales British Museum, 1871, p. 54.

History and Nomenclature.

The first accurate account of this little-known whale was published in 1822 by Rudolphi who, however, supposed it to be the same species as *Balaenoptera aculo-rostrata*. His illustrated paper gives details of the structure, under the name *Balaena rostrata*, of an individual taken in 1819 in the North Sea, and preserved in the Berlin Museum. Six years later, Lesson (1828) in his supplement to Buffon's works on natural history bestowed on it the name *Balaenoptera borealis* which it still retains, basing his account primarily on Cuvier's description (copied from Rudolphi) of the North Sea skull and partly on some notes supplied him by a French officer of the Health Department, concerning a specimen stranded on the Isle of Oleron, west coast of France. In 1846, J. E. Gray in his classic review of the whales (in the Zoology of the Voyage of the Erebus and Terror) recognized that Rudolphi's monograph was concerned with another species than that to which the name *rostrata* rightly applied, and he therefore renamed it *Balaenoptera laticeps*, ignoring Lesson's previous application of the name *borealis*. In 1864, he placed the species in his genus Sibbaldus which he erected to include this whale and the Sulphurbottom (to which he as well as several other naturalists wrongly applied the specific name *borealis*). Flower uses this name emended to *Sibbaldius laticeps*, but in the same paper (perhaps through inadvertence) uses also *Physalus laticeps*, and calls attention to the fact that *laticeps* is somewhat of a misnomer. Four years later, in 1868, Gray proposed for it a separate

genus, using the name *Rudolphius* which in a subgeneric sense he had given it in 1866. Subsequent investigation fails to uphold Gray's views on the distinction of cetacean genera, and it is now universally accepted as a species of the genus Balaenoptera.

Since the description by Rudolphi of a skeleton in the Berlin Museum formed the basis of Lesson's name *borealis*, (though he refers only to Cuvier's figure and description in the Ossemens Fossiles, taken from Rudolphi's account), this specimen becomes the type. It was found cast ashore on the German coast of the North Sea at Grömitz in the province of Holstein, in 1819.

Vernacular Names.

In recognition of his having first made this whale known to science, it is called Rudolphi's Whale or Rudolphi's Rorqual, but this is a book name, as also the name Lesser Rorqual or Lesser Fin Whale, in reference to its smaller size in comparison with the Common Finback which it somewhat resembles. On the Norwegian coast it goes by the name of Sejhval (or Seihval) among the fishermen, that is, Pollack Whale, or Coal-fish Whale since it appears in those waters at about the same time as the Pollack or 'Coal-fish' though it is not known to eat that fish. Though the term Pollack Whale is sometimes used as the English equivalent of the Norwegian word, it has been anglicized into 'Sei Whale' among whalemen of the Newfoundland coasts, and by the Germans has become Seiwal. The French speak of it as the "Rorqual du Nord." The term Black Whale is sometimes applied to this species but belongs more properly to the North Atlantic Right Whale.

Illustrations.

Excellent figures of the exterior of this whale are given by Collett in his monograph of 1886 (Proceedings of the Zoological Society of London, 1886, plates 25, 26). Two of these figures show variations in the amount of white on the belly, which is more restricted than in the Finback Whale. More recently, Andrews (1916) has published an extensive monograph summarizing and amplifying our knowledge of this whale. His excellent photographs, as well as a general figure to scale by Mr. J. H. Blake (Plate 40), very thoroughly illustrate the species.

Description.

Form.— The body is less slender than in the Common Finback. The pectoral limbs are said to be relatively smaller than in the other species, and the dorsal fin large and falcate, is situated anterior to the commencement of the last third of the length.

Plicae.— Collett gives the number as from 30 to 44 with some 8 to 10 shorter folds at the sides, a total of "38 to 58," and so considerably fewer than in the Common Finback.

Color.— The dorsal surfaces are described as bluish black or occasionally somewhat brown;

not so blue, however, as in the Sulphurbottom. Millais, with the advantage of an artist's training, says its color in life is "dark sepia suffused with gray." Laterally the color pales and becomes a dark steel gray along the sides of the body. A sharply defined white area begins at the chin and extends along the middle of the belly to the genital region. On the breast the white area is narrowed and sometimes quite cut across by encroachment of the color of the sides. Behind the vent the body is bluish gray including the whole underside of the flukes. The pectoral limbs are colored above like the back, but on their inferior surfaces they are a trifle paler, with sometimes large whitish spots, though "never....absolutely white." The white of the belly is often asymmetrical in disposition. Collett describes numerous oval blotches of a whitish color, appearing on the dark parts of the body, but Andrews (1916) shows that these are marks due to parasites (see Japha, 1905).

A careful comparison is much to be desired between the coloration of this whale and that of the Finback. To judge from descriptions Rudolphi's Rorqual has the white of the ventral surfaces more restricted. Andrews (1916) in his monograph just issued has very fully described color variation in Pacific specimens.

Hair.— In a foetus of this whale, Collett found two rows of seven hairs each, one on each side of the rostrum. On the lower jaw were seventeen hairs on each side in three longitudinal rows, consisting of three each in the upper and the lower rows, and eleven in the central row, a total of 48 hairs. In an adult female, however, only two hairs were found on each side of the upper jaw and on each lower jaw a row of eleven. According to Braun (1904) there are about fifty hairs. Japha (1911) has investigated the microscopic structure of these, and found that those on the chin were noticeably different from the others. Their bulb is not set so deeply in the skin, and the nerve supply is richer, suggesting a tactile function.

Baleen.— The baleen or 'whalebone' of this species is highly characteristic in appearance. Its color is black, but the fringing bristles of the inner edge are *whitish*, and of a fine and fibrous texture, almost like wool in comparison with the coarser whitish bristles of the Common Finback. They form a very densely matted mass. In occasional individuals some of the anterior plates may be wholly or partly white, and this condition may be nearly the same on both sides. The number of plates, counting them from the exterior, is given by Collett as from 318 to 339. In texture the baleen is said to be of finer quality than in any of the other Balaenopterae, and is hence more valuable commercially. The longest plates occur at about the beginning of the final third of the series, and may reach a length of 640 mm. (about 25 inches).

External Measurements.— No detailed measurements of New England or of Western Atlantic specimens are available. Collett says that the largest one measured by him in Finmark was 16.3 meters or 53.5 feet long, a male. The largest female he saw was but 14.7 meters or 48.2 feet. Specimens as small as 10.1 meters (33.1 feet) were noted, but these may not have been adult. The largest recorded Atlantic specimen was 57 feet long (Haldane). It is evident

then that it is a smaller whale than the Common Finback, though not so small as the Little Piked Whale.

Skeleton.— According to Flower, Gray was mistaken in supposing that the skull was proportionally very broad. Its form is in general like that of the other members of the genus. The nasal bones are *almost straight across* at their anterior ends, slightly longer at the middle, and raised along the midline to a low ridge. The coronoid processes of the lower jaw are short and obtusely triangular. The length of the skull of a 30-foot specimen was 6 feet 7 inches (2.00 meters). The neck vertebrae are seven as usual, and in the skeleton at Leyden the five posterior ones have the vertebrarterial canal incomplete where the lateral processes fail to unite at their tips. In the Brussels skeleton, however, they are joined in the first, second, and third vertebrae. The processes are of about equal length throughout except that in the sixth vertebra the lower one is shorter than the upper. In this skeleton thirteen pairs of ribs are present but according to Flower, a fourteenth pair of floating ribs has probably become lost. The first rib in this specimen had a bifid head, and articulated with the seventh cervical as well as with the first dorsal. All the ribs had tubercular articulations, and the second, third, and fourth had in addition slender capitular processes or heads which, however, did not articulate with the vertebral bodies. The sternum was lozenge-shaped, 8 inches broad, and 4 inches in its lengthwise dimension.

Andrews (1916) summarizes and corrects previous observations as to the number of bones in the vertebral column. The normal formula he gives as 7 cervicals, 14 dorsals, 13 lumbars, and 22 or 23 caudals, total 56 or 57.

The skeleton of the hand has lately been investigated and figured by Kunze (1912). As usual, there are two series of bones in the carpus: a proximal row consisting of ulnare, radiale, and intermedium, and a distal row of two carpalia. The pisiform is also present at the external side of the carpus. Kunze's figure (1912, p. 619) is apparently the first hitherto published showing the carpus of this whale, though it does not differ essentially from that of the Common Finback. The number of phalanges in the four digits is respectively 4, 6 or 7, 6 or 5, and 4, beginning with the exterior digit. In foetuses, there seems to be indication of an eighth phalanx in the longest digit (II).

The pelvic bones have been described and figured by Struthers (1893, p. 323, pl. 20, fig. 7) from an immature individual taken at Orkney. These have a less pronounced pubic process (if so it may be interpreted) than do those of the Common Finback. The total length of each bone was about 7 inches of which the terminal cartilages composed 1.5 inches. The right bone was broader than the left, and possessed a marked oval area corresponding to the place where the acetabular cartilage lies in the Finback, about one-half inch long by one-third inch wide. A notch is present on the external border, just anterior to the pubic process, corresponding perhaps to the foramen sometimes seen in the pelvic bone of the Finback. Struthers discovered no trace of a femur in his specimen.

The following measurements of the skull are taken from Flower's (1864) description of a specimen at Utrecht, Holland.

Measurements of the Skull of Rudolphi's Whale.

(Specimen at Utrecht, Holland).

	Ft.	In.	Meters	Percent of Length of Skull
Length of skull in a straight line	9	10	2.99	100
Breadth of condyles	1	3	0.38	12.7
" " exoccipitals	3	0	0.91	30.5
Greatest (squamosal) breadth of skull	5	0	1.52	50.8
Length of supraoccipital	2	3	0.68	22.8
Length of articular process of squamosal	2	4	0.71	23.7
Length of orbital process of frontal	1	7.5	0.49	16.5
Breadth " " " " " at base	1	10	0.58	18.6
Length of beak, from curved border of maxillary	6	1	1.85	61.8
Length of maxillary	7	2	2.18	72.8
Breadth of maxillaries at hinder end	1	3	0.38	12.7
Breadth of beak at middle, across the curve	2	8	0.81	27.1
" " maxillary at middle		11	0.27	9.3
" " premaxillary at middle		4	0.10	3.3
" " beak $\frac{3}{4}$ of its length from base	1	10	0.55	18.6
Length of lower jaw in a straight line	9	4	2.84	94.9

The general anatomy of the soft parts in this species probably differs in no important details from that of other members of the genus. The hand muscles are quite similar to those of the Common Finback, and are figured by Kunze.

For a careful and detailed account of the anatomy of a foetus of this whale, see Schulte (1916).

Range.

In the North Atlantic this species seems to be commonest in the waters of northern Europe. At the whaling stations on the coasts of Ireland, Finmark, and Iceland it is frequently captured. Occasional specimens have been stranded on the English and French coasts, but it is rare south of the Straits of Gibraltar. Racovitza believed that he observed this or a similar species in the Southern Ocean, and its presence has been ascertained about the Falklands. No doubt it occurs in Greenland waters but data are lacking. Captain Nilson informed Millais (1906) that it was at times common on the eastern Labrador coast.

Until very recently, no representative of the species was known in the Pacific Ocean, but Andrews has lately found that at the whaling stations in Japanese waters a similar whale

is captured, which therefore represents *borealis* in the North Pacific, and is considered by him (1916) to be specifically the same.

Occurrence in the Western Atlantic.— Although DeKay (1842, p. 131) as long ago as 1842, recorded a whale that stranded in the Delaware River, N. Y., as "*Rorqualus borealis*," he himself never saw the specimen and for his identification relied solely on information supplied him by Dr. Mitchill. The whale was described as 38 feet long, with whalebone from one to two feet long and "of a grey hairy appearance." De Kay adds that it had no dorsal elevation, which led Dr. Mitchill to suppose that it was "*B. boops*." Probably the specimen was a Humpback, and De Kay's description of "*Rorqualus borealis*" would further indicate that this was the case, since he mentions the "long slender" pectoral limbs and "small triangular" dorsal fin. It is probably safe to discard the record as far as it concerns the present species.

The first known instance of the presence of Rudolphi's Rorqual in the western North Atlantic was published by True (1903a), on "reliable information" of four specimens taken in Placentia Bay, on the southeast coast of Newfoundland and brought to the whaling station at Rose-au-rue during the summer of 1902. None was taken by other whaling stations on the east and south coasts. In 1903, when I visited the Rose-au-rue station, one Pollack Whale had been caught that year, about the first of September, and others were reported seen. I examined the characteristic baleen of this specimen lying with other masses of whalebone just as taken from the mouth. In 1904, more stations were established on the Newfoundland coast and according to Millais, 39 Rudolphi's Rorquals were killed out of a total of 1275 whales taken at fourteen factories, that year. Since then Andrews (1916) reports two taken in each of the years 1905, 1906, 1909, and 1912.

Occurrence in New England.

The paucity of records for the Pollack Whale on the North American coast, as just indicated, makes the establishment of its place as a member of the New England fauna of especial interest. It is with much satisfaction therefore that I record it from Chatham, Mass., thus at once making its first record for New England as well as for the United States, and its most southerly locality yet known on this side of the North Atlantic. The specimen in question came ashore on the outer beach directly in front of the Old Harbor Life Saving Station, at Chatham, in August, 1910. It was visited by a number of people, including Mr. John Murdoch, to whom I am indebted for information concerning it and for a piece of its characteristic baleen. The life-savers had preserved some of the baleen plates, which with a jaw and two ribs, were given me in October, 1910, by Mr. H. E. Eldridge, Keeper of the Station and are now in the Society's possession. The remainder of the carcass had since washed away. It was reported to me as about forty feet long, and was supposed by the fishermen with

whom I conversed, to have been one of a school of "Finbacks" that had been seen offshore for several days together, in August. These they thought were "mostly small whales." At about the same time another specimen was said to have come ashore near the Chatham Life Saving Station, but this I was unable to confirm. Specimens of the whalebone are preserved in the Museum of the Society and in the Museum of Comparative Zoölogy, and I am indebted to Mr. J. Henry Blake for a photograph of the whale at the Old Harbor Station. This picture (Plate 13, fig. 1), taken by a casual visitor, is here reproduced. Though taken 'head on,' it indicates the relatively short body as compared with a Common Finback, and shows the high dorsal fin and pointed tapering snout. The fact that a school of "small" Finback Whales had been seen offshore previous to the stranding of the one (or possibly two) individuals, coupled with the known gregarious habits of this species, raise a presumption that there may have been a small school of Pollack Whales off the Cape Cod shores in August, 1910. It is also evident that schools of Finbacks reported from time to time on the coast may contain individuals of the present species, which, however, would be difficult of identification at sea.

Habits.

Previous to the last few years our knowledge of the habits of this whale was chiefly confined to the paper by Collett in 1886.

Collett was told by the whalers that when not feeding, the Pollack Whales swim swiftly and do not appear to blow so often as the larger species, but spout only once or twice when coming to the surface. When feeding in the plankton currents they swim slowly with the upper part of the head and back fin out of water.

Recent observations on the Irish coast (Lillie, 1910) indicate the presence there of this whale in late May and early June, after which none was taken by the whalers. In Finmark, however, they were found as early as May 14 and as late as September 8, though in a course of years the time varied more or less. Usually they did not appear in the Finmark waters till middle or late June, and were most common in the months of July and August. Statistics of the Finmark whaling stations, as compiled by Rawitz (1900, p. 104) show that *B. borealis* is the commonest of all the whales taken on that coast, which may be due in part as that author supposes, to the fact that it frequents coastal waters rather than the high seas, and often approaches very close to the land. Rawitz believes that it does not appear in the more northern waters until they have attained a summer temperature of 9° C., but it may be that it is the effect of temperature on the food of the whale that regulates its appearance, and that the migratory movements which seem to be indicated are wanderings northward in pursuit of food.

Millais credits it with an ability to swim as fast as twenty-five knots an hour, but this must be received with caution. It seems to be somewhat gregarious, and usually goes in schools

up to as many as fifty individuals. Their association, however, is somewhat irregular and not as with fish that go in compact masses. Probably it is partly the presence of plankton in favorable currents that brings them into association.

At the Finmark stations, Collett observed large foetuses in whales of this species taken during the summer. Although there was much variation in the size of foetuses taken at approximately the same dates, none the less it seemed to be generally true that those of spring or early summer were smaller than those found later in the season. Thus in July most of those seen were from three to four feet long, while in August some were seen up to eight, ten, or twelve feet in length. This indicates a rapid growth, and leads to the supposition that copulation takes place in winter and that the young are born in the fall or winter following. As in whales generally, a single young one is normally produced at a birth. Collett records one instance, however, in which *two* young, each six feet seven inches long, were taken from a female 43 feet long on the Finmark coast at Varangerfjord, July 27th.

Food.

The Pollack Whale is believed to be almost altogether a plankton feeder, and so far as known subsists chiefly on the minute copepod *Calanus finmarchicus* and the schizopod *Thysanoëssa inermis*. The former is probably taken largely at the surface, where it often appears in such dense masses as to redden the sea, yet it is but four or five millimeters in length. It is suggested by Collett that the very fine wool-like bristles of the whalebone in this whale are an adaptation for sieving out this minute prey. The schizopod is perhaps taken at greater depths or on the surface at night, since it is sensitive to bright light and is less commonly near the surface by day. Andrews (1916) has lately published his observations on this species in Japanese waters, where he found that small fish were sometimes taken.

Commercial Value.

The yield of oil in this whale is comparatively small, averaging, according to Collett, 17 to 23 hectoliters or 14 to 20 barrels, but may be as much as 25 or 30 barrels from large fat individuals. In 1886 this oil was valued at from $135 to $165 per whale. It is of good quality and contains less stearine than that of the other species of Balaenoptera. The baleen, though short, is considered the best of that produced by any of the Rorquals on account of its finer grain. In Finmark the flesh of this species is canned for human consumption. It is considered to be superior to that of the other species taken, and alone is preserved. Guldberg (1885) describes it as in color about the same as beef, whereas that of the other Balaenopteridae is much darker.

Enemies and Parasites.

Nothing is known of the enemies of this species or of the natural causes that act to keep its numbers in check. No doubt the Killer Whale occasionally troubles it, but no record is known to me that would prove this.

Sundry parasitic crustaceans and worms are known from this whale, but it does not support barnacles. Collett reports what were probably Penellae attached to the edges of both flukes, but he did not personally examine them. These parasites Andrews (1916) has now shown to be the cause of the oval whitish marks described on the body of this whale. The copepod *Balaenophilus unisetus* was first found in this whale by Collett. It infests the whalebone plates to which both the larvae and adults cling in thousands. Figures are given of both stages in the Proceedings of the Zoological Society of London, 1886, p. 257.

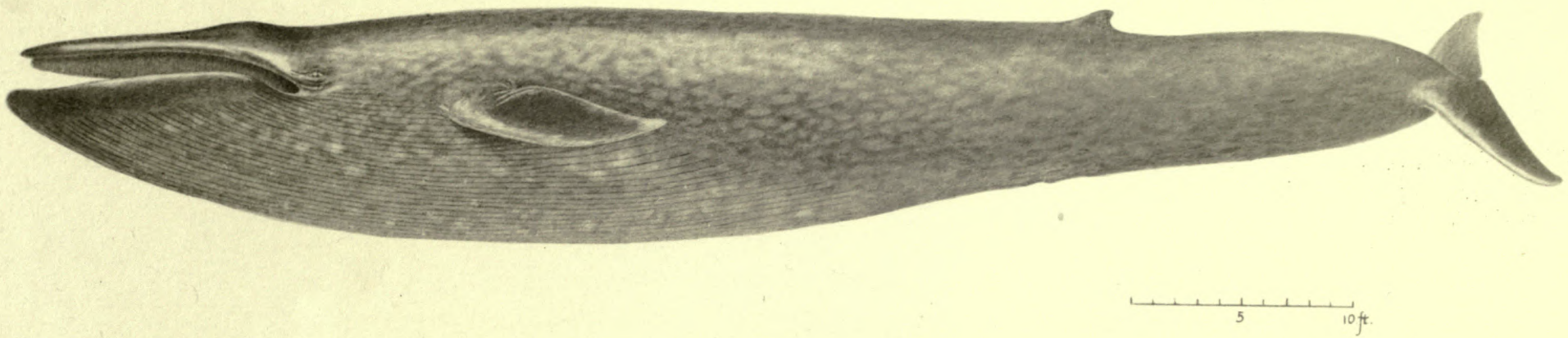
Mörch (1911, p. 668) writes of a Rudolphi's Rorqual killed in 1906 at the Shetlands, which had the front end of its lower jaw deformed, and so afforded a foothold for a colony of the stalked barnacle, *Conchoderma auritum*. This is exceptional, however, for under normal conditions this whale does not harbor barnacles.

Of internal parasites, Collett found two sorts of intestinal worms, one of which appears to be identical with *Echinorhynchus porrigens*, and has also been recorded by Borgström from this whale. The other Collett describes as a new species, *E. ruber*, but it has been shown that it is the same as *E. turbinella* Diesing. This latter varies in size according to the degree of maturity up to about 25 mm. in length, is transparent when young but bright red when full grown. *E. porrigens* is also orange red in color. These parasites attach themselves by a head, thickly studded with spines, to the inner wall of the small intestine, and absorb their nourishment from the digesting food. They pass only a part of their life as parasites of the whale, for the first stage is lived probably within some crustacean on which the whale feeds. Figures of these two Echinorhynchi are given by Borgström (1892).

Two species of tape worm are known to occur in the intestinal canal of Rudolphi's Whale. Both were described by Lönnberg (1892) from specimens collected at a whaling station in Finmark. The first, *Bothriocephalus balaenopterae*, is made the type of a new subgenus Diplogonoporus. Its scolex or sucking disk by which it attaches itself to the intestinal wall, is flattened from side to side, with a sucker, shaped in outline like a tennis racquet. The second species, *Tetrabothrium affine*, has a curiously four-parted scolex of four round petal-like disks. It is allied to a species found in the large shark, Lamna.

PLATE 12.

Blue Whale or Sulphurbottom (*Balaenoptera musculus*). Drawn by J. Henry Blake after measurements by True (1904) of a Newfoundland specimen.



BLUE WHALE.

HELIOTYPE CO., BOSTON

Balaenoptera musculus (Linn).

Blue Whale; Sulphurbottom Whale.

Plate 11, fig. 3; Plate 12; Plate 13, fig. 3.

Synonymy.

1758. *Balaena musculus* Linné, Syst. Nat., ed. 10, vol. 1, p. 76.
1803–4. *Balaenoptera jubartes* Lacépède, Hist. Nat. des Cétacés, vol. 1, p. 176, pl. 4, fig. 1.
1820. *Balaenoptera gibbar* Scoresby, Arctic Regions, vol. 1, p. 478 (not of Lacépède).
1828. *Balaena maximus borealis* Knox, Cat. Prep. Whale, p. 5.
1828. *Balaenoptera musculus* Fleming, Hist. British Animals, p. 30; True, Proc. U. S. Nat. Mus., 1898, vol. 21, p. 632.
1829. *Balaena borealis* Fischer, Synopsis Mamm., p. 524 (in part; from Dubar).
1832. *Balaenoptera rorqual* Dewhurst, Loudon's Mag. Nat. Hist., vol. 5, p. 214 (in part, includes Dubar).
1836. *Rorqualus boops* Cuvier, Hist. Nat. des Cétacés, p. 321 (in part).
1837. *Rorqualis borealis* Jardine, Naturalist's Library, Mammalia, vol. 6, p. 125 (in part).
1847. *Physalus (Rorqualus) sibbaldii* Gray, Proc. Zool. Soc. London, p. 92.
1857. *Balaenoptera gigas* Reinhardt, in Rink's Grönland Geographisk, og Statistisk Beskrevet, Bidrag, vol. 1, pt. 2, p. 10.
1861. *Pterobalaena gigas* van Beneden, Mém. Acad. Roy. Sci. Belg., Bruxelles, vol. 32, art. 3, p. 37.
1863. *Pterobalaena gryphus* Munter, Mitth. Naturw. Verein von Neu-Vorpommern und Rügen, vol. 9, p. 1–107.
1864. *Sibbaldus borealis* Gray, Proc. Zool. Soc. London, p. 223.
1864. *Physalus latirostris* Flower, Proc. Zool. Soc. London, p. 419.
1866. *Sibbaldius borealis* Gray, Cat. Seals and Whales British Museum, ed. 2, p. 175.
1866. *Cuvierius latirostris* Gray, Cat. Seals and Whales British Museum, ed. 2, p. 165.
1866. *Cuvierius sibbaldii* Gray, Cat. Seals and Whales British Museum, ed. 2, p. 380.
1866. *Balaenoptera carolinae* Malm, Nagra blad om hvaldjur i allmaenhet og Balaenoptera carolinae i synnerhet, Goeteborg.
1867. *Flowerius gigas* Lilljeborg, Nova Acta Reg. Soc. Sci. Upsala, ser. 3, vol. 6, art. 6, p. 12.
1871. *Cuvierius carolinae* Malm, Kongl. Svenska Vet.-Akad. Handl., vol. 9, art. 2, p. 42.
1875. *Balaenoptera sibbaldii* G. O. Sars, Forhandl. Vidensk. Selsk. Christiania, 1874, p. 227.

History and Nomenclature.

Although the specific name *musculus* has long been almost universally applied to the Common Finback, True (1898) has now conclusively shown that Linné's *Balaena musculus* was based on the description by Sibbald, of a specimen of the Blue Whale cast ashore in the Firth of Forth, Scotland, in September, 1692. This discovery necessitates an unfortunate interchange of names, but Sibbald's description is unmistakable, and constitutes the first attempt to bring the species before the attention of naturalists. In recognition of this, Gray in 1847, proposed that the species be called *Physalus sibbaldii* and later placed it in a separate genus

Sibbaldus (changed shortly after to Sibbaldius by Flower), with the specific name *borealis* of Knox (1828). This latter was unfortunately preoccupied by Lesson's *borealis* for the Pollack Whale. Curiously, in his Catalogue of Seals and Whales, published in 1866, Gray applies no less than three different names to the Blue Whale, but the supposed differences were not of the importance he assigned them. Thus his *Physalus sibbaldii* was based largely on a skeleton preserved at Hull, and his *Sibbaldius borealis* was founded in part on Dubar's (1828) description of a specimen cast ashore at Ostend. In the same work he erects the genus Cuvierius to include the single species (*Physalus*) *latirostris* of Flower (1864) but in the Additions and Corrections, states that this is the same as *Physalus sibbaldii* and that the name should stand as *Cuvierius sibbaldii*. To the same genus was referred the subfossil *Balaenoptera carolinae* of Malm, now synonymized with the Blue Whale. Lacépède, in 1803–4, revised the classification of these whales, and introduced sundry new names into the nomenclature. He founded the genus Balaenoptera, to embrace the Finner Whales, and included the Blue Whale under the specific name *jubartes*, though his description probably applies in part to at least two other species, the Common Finback and the Humpback. No doubt it is in a measure due to this confusion, that later authors found some difficulty in applying his names. Thus Scoresby (1820) describes a Blue Whale under the title *Balaenoptera gibbar*, and Dewhurst (1832) includes Dubar's Ostend Sulphurbottom under *Balaenoptera rorqual*, names which are primarily synonyms of the Common Finback. The British naturalist Fleming was the first to call it *Balaenoptera musculus*, its correct name. Later authors placed it successively in the genera Rorqualus, Physalus, Pterobalaena, Sibbaldius, Cuvierius, Flowerius, but it is now recognized that the differences on which these supposed genera were based, are chiefly small matters of individual variation. Eschricht in his important memoir of 1849, proposed the name Pterobalaena in a group sense, to include the species now referred to Balaenoptera. This was later used as a generic term by Van Beneden, who in 1861 adopted the combination *Pterobalaena gigas*. The specific name *gigas* had been proposed four years earlier by Reinhardt in spite of the fact of prior names. The labors of J. E. Gray, as already pointed out, hardly settled the matter, and most later writers have followed G. O. Sars (1875) in calling the Blue Whale *Balaenoptera sibbaldii*. Finally, True in 1898 restudied the Linnaean references, and conclusively showed that Linné's *Balaena musculus*, which had long been in use for the Common Finback, applied after all to the Blue Whale.

The type locality of this species is, as given by Linné, "in mari Scotico." The name, as just mentioned, was based on Sibbald's description of a specimen from the Firth of Forth, Scotland.

Vernacular Names.

This, the largest of living mammals, is often spoken of as Sibbald's Whale or Sibbald's Rorqual after the Scotch naturalist of that name who first brought it to the notice of scientists in his work on whales of the Scottish coasts, published in 1692. From its size and habitat, it is also called the Great Northern Rorqual, but more commonly Sulphurbottom Whale, or Sulphurbottom (shortened by the Newfoundland whalers to 'Sulphur'), notwithstanding that the latter term is a gross misnomer. How this name arose is not altogether clear, though Scammon, in writing of the representative of this whale in the Pacific Ocean, supposes it is descriptive of "a yellowish cast or sulphur color," which he says, is in some instances to be noted on the under surfaces. It seems better to use the more descriptive epithet of Blue Whale, which indicates the slaty-gray of its color. This is merely following Norwegian usage, however, since Blue Whale is but a translation of 'Blaahval,' first applied to it by the Norwegian whaler, Capt. Svend Foyn, and formally adopted by Sars (1875). It has brevity to recommend it as well. The German word is 'Blauwal,' after the Norwegian. In Icelandic it is called 'Steypiredyr,' meaning a great whale.

Description.

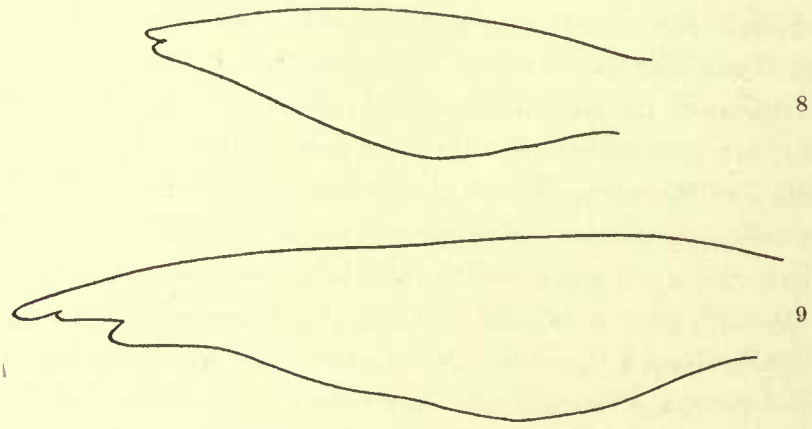
Form.— Compared with the Common Finback, the Blue Whale is longer of body but the head is differently shaped, with a broader muzzle, the sides of which are bowed outward instead of being nearly straight. A prominent ridge runs forward from the blowholes on the center of the snout. The pectoral fin is slightly longer in proportion and its outline characteristically different. Its outer margin is more convex, and its inner margin a long sigmoid curve, with more of a concavity near the tip. Frequently the tip is serrated as if the ends of the four fingers projected slightly at the margin of the paddle. This was seen in several cases at Newfoundland by True and by myself (see text-figs. 8, 9). Sars also mentions it. Sometimes this appearance may be present on but one side only. True believed that this irregular margin of the end of the pectorals was "due in most cases to external injury." Certainly, however, it may be a perfectly normal occurrence, since a foetus from Newfoundland which I dissected, had a small notch at the tip of each pectoral, forming an emargination between the two longest digits (II and IV), as shown in outline in text-fig. 8.

The adipose fin at the lower part of the back is generally much smaller in proportion, than in the other Balaenopterae, nearly an equal-sided triangle in outline with a concave hinder margin.

As in the Common Finback, the eye is behind and a little above the angle of the mouth. The eyeball itself in a 71-foot animal was 5 inches in antero-posterior length and 4.5 inches in

vertical height according to True (1904, p. 175). The iris was brown and the pupil "oblong with a straight superior margin."

The mammae are two in number as in other whales, concealed each in a longitudinal slit



TEXT-FIGS. 8, 9.— Outlines of pectoral limbs of Blue Whales (*Balaenoptera musculus*) showing emarginations between the fingers.

8.— From a foetal specimen (original).
9.— From a photograph of an adult at Placentia Bay, Newfoundland (original).

opposite the vaginal opening. Rudimentary mammae are present in the male. The penis is retractile within the body, some six feet in length.

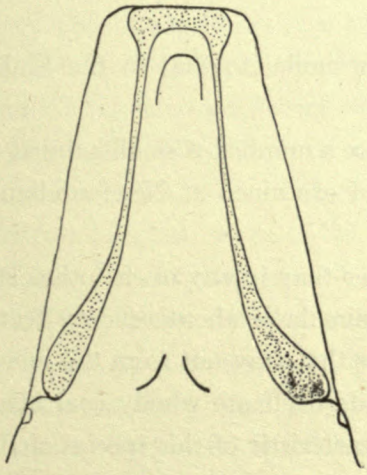
Plicae.— The plicae or ridges and furrows of the ventral side, extend from the lower margin of the lips to the navel as in the Common Finback. Side branches come off irregularly, uniting adjacent ridges, and towards the posterior part of the thorax they run together, so that the number is much reduced there as compared with that on a line between the forelimbs. True found a variation of from 58 to 88 ridges between the roots of the pectorals in Newfoundland specimens, and this is apparently not correlated with size or sex.

Color.— The general coloration is a slaty-gray, with a decidedly bluish cast, darker on the head, lips, and throat, paler along the sides. The shoulders, back, and sides are irregularly mottled with small grayish patches. Millais describes a freshly killed specimen as "pale blue gray." The belly, including the area of the throat folds and thence posteriorly to the navel, has small scattered white marks of irregular shape, some larger, some smaller, but rather sharply outlined. These are usually most abundant at the lower part of the throat. In some specimens the white flecks extend forward even to the lips, but usually there are but few in front of the pectoral fins. True observed a few cases in which they were so numerous under the root of the pectoral as to form a large white band extending backward toward the navel; in others they are confined to the posterior portion of the ventral folds, in the middle. There is great individual variation in these details. The dorsal fin is likewise more or less marked with

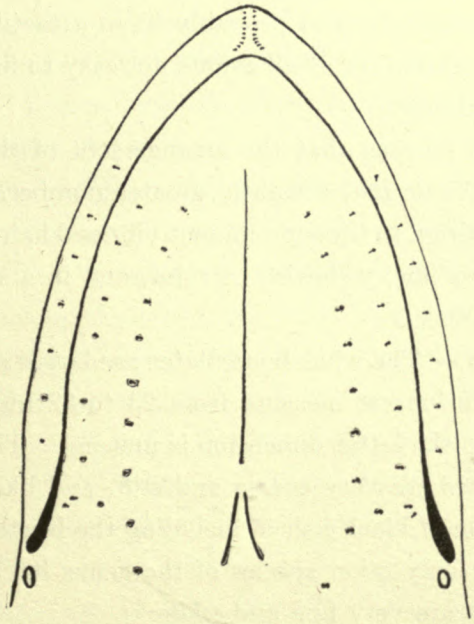
whitish over its central part. "The pectorals are gray above and more or less distinctly mottled like the back. The under surface, anterior margin, and tip above and below are white" (True, 1904). The extent of the white tip on the outer surface may be as great as two feet. The flukes underneath are usually colored like the back, with, however, more or less of greyish streaks at the base, running posteriorly. In some individuals the flukes are nearly white below, with the usual streaks of light gray. The inside of the mouth is black, the tongue slate gray.

In life, the appearance of the back as it comes above water, is mouse color or elephant gray. After death, as in all whales, and with exposure to air, the colors of the body rapidly darken and eventually become quite black, so that unless freshly killed specimens are examined, it is difficult or impossible to judge of the true color of the animal.

Hair.— As in other whales of this genus, hairs are present on the head only, and their number and arrangement are of a very definite nature. In a foetal Blue Whale from Newfoundland, 630 mm. long, I found on each side of the snout two distinct longitudinal rows running parallel to the edge of the upper lip. The inner row consists of nine single bristles,



10



11

TEXT-FIG. 10.— Head of North Atlantic Right Whale (*Eubalaena glacialis*) from above, to show narrow rostrum and divergent blowholes (from a photograph of the Provincetown 1909 specimen).

TEXT-FIG. 11.— Head of a foetal Blue Whale (*Balaenoptera musculus*) to show broad rostrum, slightly divergent blowholes, and the arrangement of the hairs (original).

rather evenly spaced, the hindermost of which is just back of a line drawn across the posterior ends of the blowholes. The entire row forms a convex line that ends at the commencement of the terminal fourth of the upper jaw. The outer row contains but eight bristles, the two

posteriormost of which are close together, the three or four succeeding ones more widely spaced. The two hindermost bristles are much nearer the edge of the lip than the others, so that the row curves downward here, toward the corner of the mouth. Directly above these two bristles, and standing between the inner and the outer row is a single bristle (see diagram, text-fig. 11). On the upper surface of the snout there are thus eighteen hairs on each side.

On the lower jaw there are again two rows of hairs on each side, but very differently placed. At the tip of the jaw are two *vertical* rows of nine bristles each, very close together in the foetus, but three inches apart in an adult and extending the height of the lip. The rows diverge somewhat dorsally but are parallel for the lower three-fifths. The second row is on the side of the lip, and consists of seven hairs, somewhat regularly spaced. The first hair of this row is back from the tip of the jaw at about the beginning of the second quarter of its length. Instead of running parallel to the convex upper margin of the lip, this row of hairs forms a chord of the arc, on the line with the rami of the jaws.

The Blue Whale has thus in all 68 of these large hairs, each of which comes from a prominent raised follicle. They correspond more or less in position to the vibrissae or 'whiskers' of other mammals, and probably have a tactile function. In adult whales these hairs are sometimes absent, or at all events not easy to find. Possibly they become worn down or may fall out with age.

It will be seen that the arrangement of the hairs is similar to that in the Finback, but the Blue Whale has a slightly greater number.

In addition to these prominent vibrissal hairs, there are a number of small hairs at the point of the lower jaw, yellowish in color, and in a specimen I examined at Newfoundland, about fifty in number.

Baleen.— The whalebone plates are larger and coarser than in any of the other Balaenopterae. The longest measure from 23 to 32 inches in animals of about seventy feet or over (True), but the latter dimension is unusual. The bristles that fray out from the inner margin of the plates are very coarse and stiff, and like the blade itself are wholly coal black. The combination of black baleen including the bristles is characteristic of this species of Balaenoptera. The only other species of the genus having black whalebone is *B. borealis*, but in this the bristles are very fine and *white*.

Weight.— No attempt to measure accurately the weight of a Blue Whale seems ever to have been made. An approximation, however, has been attempted by Guldberg (1907) for this species, using the same method described under the Common Finback. By considering the body of the whale to resemble in shape a solid composed of two cones, a longer and a shorter of equal basal area, it is possible by a mathematical formula to calculate the volume of this solid, and thus, by assuming a specific gravity equal to that of water, to obtain the weight of such a body. To make this calculation, two measurements are needed: the total length in

a straight line and the girth. These dimensions for twenty-one Blue Whales were obtained by Captain Berg, at an Icelandic whaling station and were used by Guldberg in his calculations. Of these twenty-one whales, the extremes of length were 61.5 and 84 feet, and the extremes of greatest girth 32 to 40; the averages of these dimensions were respectively 72.45 feet and 36.02. By applying these figures in the formula the weight of a 72-foot Blue Whale is found to approximate 73.8 tons or 73,800 kilograms. This, it must be remembered, is an approximation only, as no account is taken of the large pectoral limbs or of the flukes. Moreover the form of the body before and behind the point of greatest girth is not exactly that of a cone. Turner has independently estimated the weight of a Blue Whale at about seventy tons. According to Andrews,[1] a 76-foot Blue Whale from Newfoundland, of which the American Museum of Natural History has a life-size model, was said to weigh 63 tons.

External Measurements.— The greatest length to which this species may attain is still a matter of some doubt. Measurements exceeding 100 feet have been recorded, and estimates of large individuals run as high as 132 feet. It is now agreed, however, that such figures are unreliable, or were taken in such a way as to exaggerate the true length. The best series of measurements extant is that given in True's monograph (1904, p. 153). Of twenty-five Blue Whales measured at Newfoundland, the largest was 77 feet 2 inches from the tip of the upper jaw to the notch of the flukes in a right line. This is probably nearly a true maximum, but may be exceeded. Measurements from Norwegian stations run up to 87 feet 6.5 inches, but may have been taken in a different way. There is evidence that females may grow to a larger size than males, but the difference, at most, is slight, and might disappear with larger series. Thus of the ten males measured by Dr. True, four exceeded seventy feet, though the largest was but 72 feet 7 inches; while of the fifteen females, six were seventy feet long, four were over 73 feet, and the longest of all was 77 feet 2 inches, as above noted. Yet the average of the ten males and of the sixteen females is respectively 68 feet 3 inches and 68 feet 9 inches, a very trifling difference in such great creatures. The smallest female with a foetus (and so adult) that Dr. True measured, was 72 feet long. At the Norwegian stations, Cocks (1885) found that the largest of thirty-six females exceeded by 2 feet 6.5 inches the largest of an equal number of males.

No measurements of New England specimens are available, but the following, based on Dr. True's lists, indicate the proportions of an adult male and an adult female. As with the Finback, I have worked out the percentage of each dimension to the total length.

The height of the dorsal fin is usually between 6 and 10 inches but in three cases out of twenty-four exceeded a foot by from 2 to 3.5 inches, thus nearly equalling the smallest measurements for adults of the Common Finback. The other measurements seem to vary but relatively little.

[1] Amer. Museum Journal, 1914, vol. 14, p. 279.

External Measurements of Blue Whales (after True, 1904).

	Newfoundland ♂ No. 18				Newfoundland ♀ No. 4				Newfoundland ♂ No. 10			
	Ft.	In.	Meters	%	Ft.	In.	Meters	%	Ft.	In.	Meters	%
Total length, snout to notch of flukes	72	2	22.1	100	73	6	22.40	100	72	7	22.12	100
Tip of snout to eye	16	0	4.98	22.0	16	3	4.95	22.1	15	3.5	4.65	21.0
" " " " blowhole (center)	13	8	4.17	18.8								
" " " " posterior insertion of pectoral	25	3	7.70	34.7	25	6	7.77	34.7	25	5	7.75	35.01
Tip of snout to posterior base of dorsal fin	55	11	17.04	77.0	56	10	17.32	77.3				
Notch of flukes to anus	19	6	5.94	26.8	19	7	5.97	26.6	20	8	6.30	28.47
" " " " clitoris					21	9	6.63	29.5				
" " " " penis (center of orifice)	24	5	7.44	33.6					25	5	7.75	35.01
Length of pectoral from head of humerus	11	0	3.35	15.1	11	0	3.35	14.9	11	7	3.53	15.95
Length of pectoral from tip to posterior insertion	7	5	2.26	10.2	7	7	2.31	10.2	7	10	2.39	10.79
Greatest breadth of pectoral	2	9	0.84	3.79	2	8	0.81	3.62	3	0	0.91	4.13
Height of dorsal fin	0	8.5	0.21	0.97	0	7.5	0.19	0.85	0	10	0.25	1.14
Center of eye to center of ear opening	3	8.5	1.13	5.11	3	8	1.12	4.98	3	10.5	1.18	5.33
Breadth across flukes	16	10	5.13	23.21								
Length of longest whalebone	1	11	0.58	0.26					1	11	0.58	0.26

Musculature.— There is no complete account of the muscular system of the Blue Whale published, but it probably differs little from that of the Common Finback. A foetus of 630 mm. length that I dissected had the same rudimentary finger muscles as in that species (*q. v.*), so that Struthers' account and figures would apply equally to both. The great superficial muscles are prominent in the foetus and are exposed by carefully removing the thin layer of blubber (2 mm. in thickness), to which they are attached by loose connective tissue. The more dorsal layer seems to correspond to a *panniculus* and extends as a thin sheet from a point midway between the eye and pectoral limb, back nearly to the anus. It does not reach the mid-line of the back, though thin fasciae extend from its upper edge nearly to the spine. Its lower border forms a line joining the axilla and the anus. On the region of the forearm it passes into a tendinous sheet that invests the upper part of the limb, but I did not discover a definite insertion.

The entire ventral surface from the anus forward including the basal half of the jaws is covered by a continuous sheet of muscle whose fibers run transversely from the lower edge of the panniculus. It appears to represent the *mylohyoid*. A portion of this muscle is inserted just behind the eye and on a level with it. In an embryo of this size the longitudinal throat

PLATE 13.

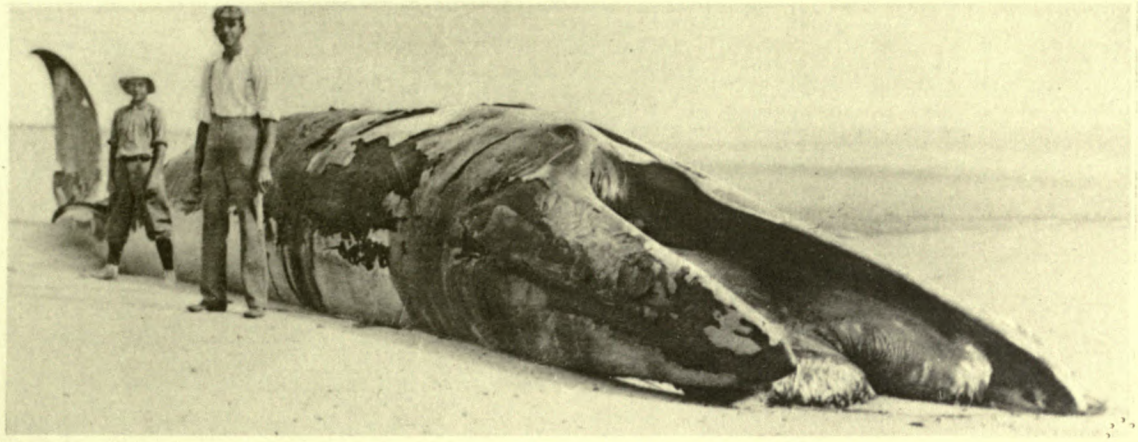
Fig. 1. Rudolphi's Rorqual (*Balaenoptera borealis*). A photograph of the specimen stranded at Chatham, Mass., in August, 1910. The whale lies on its right side, with back to the observer and though foreshortened, the figure shows in upper view the long and evenly tapering snout, the slit-like blowholes, one of the broad flukes, and (behind the right knee of the farther figure) the high dorsal fin.

Fig. 2. Little Piked Whale (*Balaenoptera acuto-rostrata*). A view of the under side of the specimen captured at South Truro, Mass., June 25, 1910. The long throat folds are seen running back half way on the belly. The white band on the pectoral flippers, the white under surface of the flukes, the relative position of the anus and mammary slits are seen.

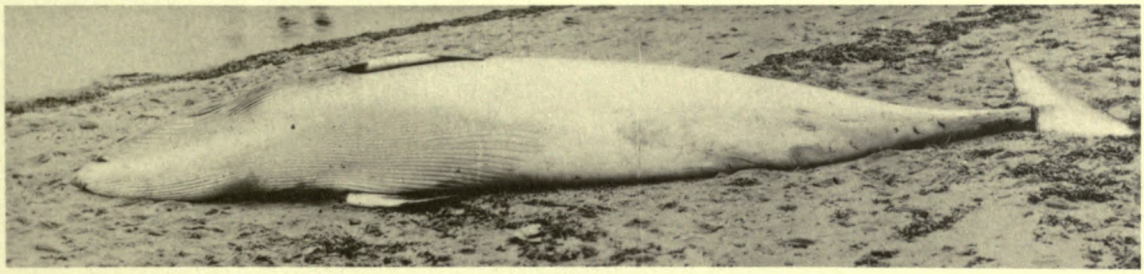
Fig. 3. Blue Whale (*Balaenoptera musculus*) in the act of spouting, seen from behind as the whale breaks water. Photographed by the writer from the deck of the whaling steamer *Puma* in Placentia Bay, Newfoundland.

Fig. 4. Common Finback Whale (*Balaenoptera physalus*) after spouting, showing the body arched as it slowly revolves out of the water and descends below the surface. Photographed by the writer in Placentia Bay, Newfoundland. The whale is progressing from the right to the left hand of the picture.

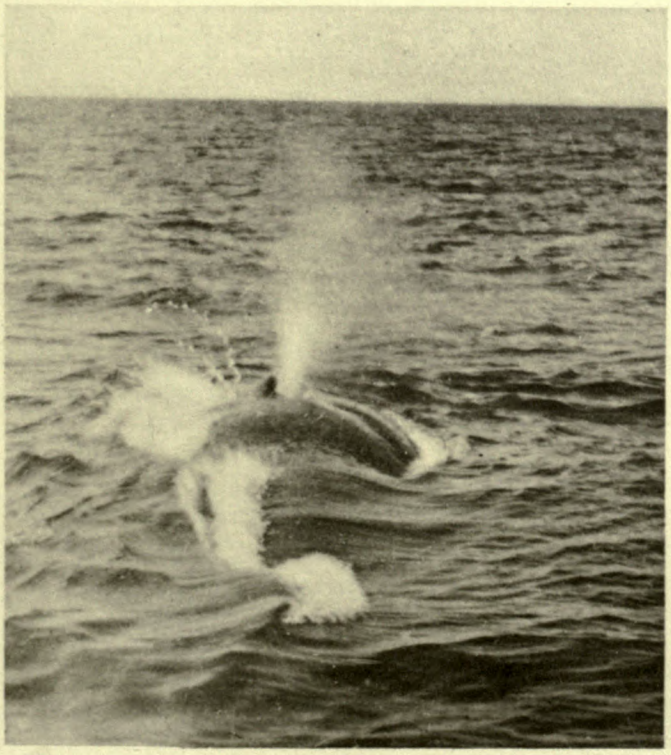
Fig. 5. Common Finback Whale about to disappear below the surface and showing the high dorsal fin, which passing forward (to the left) disappears as the body sinks. Photographed by the writer in Placentia Bay, Newfoundland.



1



2



3

4

5

NEW ENGLAND WHALEBONE WHALES.

UNIV. OF CALIFORNIA

UNIV. OF
CALIFORNIA

grooves have not yet formed, but the muscle just described will eventually become the elastic, plaited bag of the throat.

Skeleton.— The skeletal characters of the Blue Whale are still imperfectly known, and of American specimens there are very few measurements published. These relate chiefly to a New Jersey skeleton preserved in the Philadelphia Academy of Sciences. It will suffice to summarize the chief points that distinguish this species from the Common Finback.

The most obvious peculiarity of the skull is the relatively greater breadth of the rostrum, which, instead of being narrow and tapering is proportionally broader than in the Common Finback with convex outlines (Plate 11, fig. 3). Thus in the latter species the average breadth of the rostrum at the middle is about 19.6% of the length of the skull (True) while in the Blue Whale the breadth at this point is nearer 29%. The palatal bones are also broader, and the nasals are truncate across at their anterior end. In other respects the skull is much like that of the Common Finback. The principal dimensions of the New Jersey skull are given by True as follows: —

	Ft.	In.	Meters
Total length of skull, in a straight line	14	7.5	4.46
Greatest breadth at the squamosal region	7	3	2.21
Width of orbital process of frontal at distal end	0	11.5	0.29
Length of rostrum in a straight line	9	7.5	2.92
Breadth of rostrum at the middle, following curve	1	5.5	0.44
Length of lower jaw in a straight line	15	2	4.62
" " " " on the outside curve	17	1	5.28
Depth of mandible at the middle	1	1	0.33

Except for this specimen, no skull measurements of the Blue Whale are available for American waters.

The number of vertebrae is nearly the same as for the Common Finback, but the number of caudals is usually one or two more. Three foetuses dissected with care by Dr. True (1904, p. 182) at Newfoundland showed the following variation:

	Cervicals	*Dorsals*	*Lumbars*	*Caudals*	*Total*
1	7	16	15	27	64
2	7	15	14	28	65
3	7	15	16	26	65

These counts express about the usual variation and accord fairly with those published for adult European examples. The number of ribs is usually fifteen but occasionally is sixteen, and so few as fourteen are recorded in one case. The lumbars are from thirteen to sixteen, commonly fifteen, the caudals from twenty-six to twenty-eight. The total number of

vertebrae is usually 64, but varies one more or less than this. The neck vertebrae are normally separate.

The second and third ribs have well developed capitular processes, and the fourth has a smaller one, extending in toward the vertebral column. These are the vestiges of the heads of the ribs which in other mammals form the chief articulation with the centra of the vertebrae throughout the series. In the Balaenopterae this inner articulation has been lost and the ribs are loosely attached by their tubercles only, at the tips of the lateral processes of the vertebrae. In the skeleton at Ostend described by Dubar the first rib has two heads — as occasionally in the Common Finback.

The sternum is probably subject to much the same variation as that of the latter species, though the few figured specimens are somewhat similar: namely a transverse plate, with a small protuberance at its front edge and a longer one behind that extends between the lower ends of the first pair of ribs.

The scapula is fairly characteristic. Though in general much like that of the Common Finback, its upper outline is less flattened, making thus a more even arc. The acromion process is slightly larger, and expanded at the end. The coracoid process is decidedly thicker and nearly half the length of the acromion.

The radius in the Blue Whale "is remarkable for its breadth, and the ulna for its strong curvature" (True) as compared with these bones in the Common Finback. In the New Jersey specimen (60 feet long) the radius measured 32.5 inches (0.82 m.) in length and 10 inches (0.25 m.) in breadth at the distal end. The ulna was 34.5 (0.87 m.) long and 8 inches (0.20 m.) in breadth at the distal end.

The number of phalangeal bones probably varies within slight limits. The greatest number recorded is that given by True for a foetus he dissected, namely, 5, 8, 7, 4 for the respective digits. In six other specimens recorded by European authors, the variations are: I 4; II 5 to 7, IV 5 to 7, V 3 to 4.

The pelvic bones seem slightly more reduced than in the Common Finback, though of much the same general shape. Lönnberg (1910, p. 10) has figured one of the pelvic bones in a Blue Whale from the South Atlantic. He found no trace of the rudimentary femur, though on account of the immaturity of his specimen it is likely that it had not ossified. Dubar (1828) figures the pelvic bones of the Ostend Blue Whale, but the representations are poorly executed; this author likewise omits reference to any rudimentary femur.

Habits.

The Blue Whale is less social than the Common Finback, and does not seem to gather into large schools. Commonly it is seen singly or in pairs. Whales, when travelling in pairs, move in unison, rising and diving together with much regularity. As with other large whales,

there are two sorts of dives: the series of shallower or surface dives followed by the deep dive when the whale 'sounds' or goes down for a longer period. The Blue Whale after coming to the surface from a deep dive makes about twelve to fifteen of the shallow dives, then goes down again for an interval of from five to ten minutes or more. Millais has timed them at these longer dives, from ten to twenty minutes down. At each of the short dives the vertex of the head first appears and simultaneously the spout is delivered (Plate 13, fig. 3); the open nostrils then take in breath and close with the sinking of the head, which passes forward beneath the surface. Then a section of the broad back arches from the water and slides forward and under in its course, till finally the dorsal fin appears, small and low, and as it too revolves, wheel-like, the animal sinks beneath the waves. At about three times its own length (some 150 to 200 feet) it again comes to the surface, 'blows' and goes down again, until having sufficiently refreshed its lungs, it plunges into the depths, often throwing its great tail or flukes out of water at the end of the movement. Scoresby says (1820, vol. 1, p. 481) that it "very rarely throws its tail in the air" when it descends. My own observations are limited but seem to bear this out to some extent. Millais observed that "only occasionally, when actually 'on feed' does it ever exhibit the tail clear of the water," but in making its big dive, a bull "will often raise the tail clear of the water." The duration of the shallow dives is about 12 to 15 seconds.

The height of the spout varies according to conditions — whether the whale has been down long or if a wind be blowing to distort the shape of the column, which is comparatively high and expanded slightly at the summit. The Newfoundland whalemen did not pretend to distinguish the spout of the Blue Whale from that of the Common Finback, though some writers have stated that the greater size of the Blue Whale's spout is characteristic. A very successful photograph of the Blue Whale in the act of spouting I succeeded in obtaining from the deck of the *Puma* in Placentia Bay, Newfoundland (Plate 13, fig. 3). It shows the lateral lips of the blowholes well raised as the breath is forcibly expelled, and the conical shape of the vaporous column, slightly distorted by the wind. The height of the column probably does not exceed twenty feet, though estimates run as high as fifty. In Newfoundland waters I had a chance to photograph the spout of a Blue Whale at a moment when the Norwegian captain of the whaler's crew stood up to lance the whale. The comparative height of the column in the photograph (see Amer. Naturalist, 1904, p. 620) is about two and one-third times that of the man, or about fourteen feet. Rawitz estimates about a meter (3 feet). The whale in diving leaves a long 'slick' or smooth elliptical area on the surface, caused by the counter currents of water that rush in to fill the potential vacuum as the whale rises and descends.

The speed of a Blue Whale when travelling at a normal rate is in the vicinity of ten to twelve knots an hour, but when frightened it is undoubtedly much more. Two whales which we pursued in the whaling steamer *Puma* in Placentia Bay, Newfoundland, could not be overhauled after a long chase, though the little vessel was making all of ten knots an hour. We finally had to abandon the pursuit as the pair disappeared in the distance rising and spouting

together. Scoresby (1820, vol. 1, p. 479) also agrees that its speed does not exceed twelve miles an hour.

So far as known the Blue Whale does not leap out of water.

Longevity.

The normal duration of life is unknown for any of the Cetacea. Sibbald, in his Phalainologia describes a Sulphurbottom cast ashore in 1692 in the Firth of Forth, Scotland, which had been known to the fishermen thereabout "for twenty years, in its pursuits after the herring, and termed by them *Hollie Pike*, in consequence of the dorsal fin having been perforated by a bullet." Cuvier estimated the age attained by some of the larger species of Cetacea at a thousand years or more, but this was mere guesswork, and the basis of his estimate we now know to be quite inadequate.

Food.

The Blue Whale is not known to feed on fish, but appears to subsist largely, if not entirely, on minute crustaceans which it engulfs in great quantities and sieves out from the water by means of the matted bristles of the whalebone. The small schizopod *Thysanoëssa inermis* seems to form the favorite item of diet, and the stomachs of those I examined at Newfoundland were packed with these alone. Other observers have seen the same thing. Collett records from 300 to 400 liters (twelve bushels or more) of these crustaceans in stomachs of this whale. A second species of minute crustacean — *Temora longicornis* — known to the fishermen as 'swamps' — is also found in the stomach of the Blue Whale on the Newfoundland coast, according to Dr. L. Rissmüller (Millais, 1906). Van Beneden considers that Holboell is undoubtedly mistaken in believing that capelin are eaten by the Blue Whale, and in this he is probably correct.

Breeding Habits.

As with other whales, very little is definitely known of the life of this large species. Guldberg says that mating takes place in summer on the coasts of Finmark and Lapland. He speaks of observing the act of copulation on July 15, 1883, when a male and a female lay on their sides at the surface, gently approached each other and turned belly to belly. Gestation is supposed to be about a year in duration, and the young are born probably in the summer following the mating. A single young at a birth is the rule among Cetacea, but Captain David Gray, an English whaler, is reported to have seen a Blue Whale with two young ones in north latitude 79° 15′. J. A. Harvie-Brown [1] records a female of sixty feet, containing twin foetuses, that was

[1] Harvie-Brown, J. A. Ann. Scottish Nat. Hist., 1905, p. 73.

brought in to Eide Fjord, Faroe, in June, 1894. Both were males, four and six feet long respectively. The young at birth is about twenty feet long. Turner (1870) records a foetus of nineteen feet in the 78-foot specimen stranded at Longniddry, Scotland.

Geographic Distribution.

The Blue Whale is essentially a 'cold-water' species, and is found well into the higher latitudes. Blue Whales occur in the South Atlantic, the Southern Ocean, and the North and South Pacific, and seem to avoid the tropical seas. Various names have been given to those inhabiting these different parts of the sea, but it is still uncertain whether they are valid species or whether the Blue Whale is specifically the same throughout the oceans. We do not yet know the range of individual variation nor whether the characters which are supposed to distinguish the nominal species are truly distinctive. A recent writer has pointed out that these large slow-breeding animals must of necessity become differentiated into local races at a much slower rate than those which breed several times a year and of which two or three generations may in the same interval be produced. Among such quickly maturing species the chance of variations arising and being preserved, is greatly increased.

In the North Atlantic Ocean, the Blue Whale is most common to the northward of the Gulf Stream. The specimen stranded at Ocean City, New Jersey, perhaps represents nearly the normal southward limit on this side, though no doubt this may become extended. Perhaps it will eventually be found to follow the cooler inshore waters as far south as the Carolina coast, as in case of the Right Whale. In New England waters it is rare, but northward it becomes more frequent. Off Newfoundland, the Blue Whale is common in summer, and in the Gulf of St. Lawrence is taken in numbers as far up as Seven Islands. Its seasonal and numerical abundance vary much from year to year. Millais (1906) quotes Captain Nilson, who has had much experience in hunting these whales in the Newfoundland waters, as believing that they winter scattered about on the Grand Banks. On March 1, 1903, he saw over two hundred at intervals between Banquereau and St. Pierre Bank. In March is the best season for the fishing on the south coast of Newfoundland, and in May, when the ice goes out from the Gulf of St. Lawrence, they enter those waters, though many still remain off the St. Pierre Bank and as far east as Cape St. Mary. By the end of June they largely disappear, and give place to the main body of the Finbacks. From the end of June to mid-August they follow the 'kril' (the small crustaceans — Thysanoëssa) out to the south but a few come in again by late August and stay 'on the coast' till November in small numbers. Captain Nilson believes they are not far from the south coast of Newfoundland all the year round. Northward they are found at least as far as Davis Straits, the coasts of southern Greenland, and probably into Baffin's Bay, but apparently do not pass through Hudson Strait into Hudson Bay. According to

Scoresby, the Blue Whale follows the open water to the edge of the ice floes northeast of Greenland, as far as Cherie Island, Nova Zembla, and Jan Mayen, yet "it is seldom seen among much ice" in contrast to the Bowhead. "It inhabits most generally in the Spitzbergen quarter, the parallels of 70 to 76 degrees; but in the months of June, July, and August, when the sea is usually open, it advances along the land to the northward as high as the 80th degree of latitude" (Scoresby, 1820, vol. 1, p. 482). On the European coasts it is found as far south at least as the Bay of Biscay. Some numbers have lately been captured by whaling crews operating on the Irish coast, and sundry individuals have from time to time come on shore in the North Sea.

Occurrence in New England Waters.

Within the limits of New England, the Blue Whale is apparently rare. I know of no positive record for it in our waters, yet it undoubtedly does occur. G. B. Goode [1] has recorded as this species a skeleton obtained by Professor Baird at Nantucket in 1875 — No. 16039 in the collection of the U. S. National Museum. The specimen in question, however, is a Common Finback (*fide* True, 1904). Captain N. E. Atwood of Provincetown, who supplied the notes on Cetacea for Dr. J. A. Allen's (1869) list of the mammals of Massachusetts, had no personal knowledge of it on the Massachusetts coast, but declared that it was said to occur. The following instances probably relate to this whale in New England and comprise all the evidence of its presence in our waters that I have found. Of themselves they constitute most slender evidence for admitting the species to the list of New England mammals. It should probably be regarded as an occasional visitor from more northern waters, but we are still almost wholly ignorant of its true status.

1755.— A whale, which from its length, seventy-five feet, was probably a Sulphurbottom, is recorded as having been landed on King's Beach, Lynn, Mass., on the 9th of December. "Dr. Henry Burchsted rode into its mouth, in a chaise drawn by a horse; and afterwards had two of his bones set up for gate posts at his house in Essex Street, where they stood for more than fifty years." [2] "Opposite the doctor's house, the cot of Moll Pitcher, the celebrated fortune-teller, stood. And many were the sly inquiries from strangers for the place where the big whale-bones were to be seen."

1874.— About the middle of October, a number of whales (mainly Finbacks) appeared off the south coast of Massachusetts. One was shot and killed with a bomb-lance off Canapitset that was said to have been a Sulphurbottom, though no details are given (see Forest and Stream, Oct. 29, 1874, vol. 3, p. 188).

1904.— The Nantucket Inquirer and Mirror (vol. 85, no. 19, Nov. 5, 1904) reports that

[1] Goode, G. B. Fisheries and Fishery Industries of U. S., 1884, sect. 1, p. 27.
[2] Lewis, A., and Newhall, J. R. History of Lynn, 1865, p. 330.

a whale 75 feet long was washed ashore dead, at Popham Beach, Maine, about the first of November. If the measurement is correct, it indicates a Sulphurbottom.

1912.— Dr. Henry B. Bigelow furnishes me a note of a large whale seen by him about 5½ miles SE. by S. ½ S. from Cape Elizabeth, Maine, whistle on August 7th, which from its size and its small dorsal fin as compared with that of Common Finbacks seen at the same place, was without much doubt a Blue Whale.

Enemies and Parasites.

Our knowledge of the enemies of the Blue Whale is practically nothing. No external parasites are recorded for this species, but no doubt it may lodge Penellae at times. It is normally quite free of barnacles.

Malm (1867) described and figured a new species of parasitic worm, *Echinorhynchus brevicollis*, from the small intestine of a Blue Whale stranded on the Swedish coast. It is one of the so called thorn-headed worms, that anchors itself to the inner lining of the intestine by its head from which project numerous small thorn-like processes. Its body lies free in the intestine and absorbs nutriment from the digested food.

Balaenoptera acuto-rostrata Lacépède.

Little Piked Whale; Least Rorqual.

Plate 11, fig. 4; Plate 13, fig. 2; Plate 14.

Synonymy.

1780. *Balaena rostrata* Fabricius, Fauna Groenlandica, p. 40 (not of Müller, 1776).
1803–4. *Balaenoptera acuto-rostrata* Lacépède, Hist. Nat. des Cétacés, vol. 1, p. 197, pl. 8; Thomas, Zoologist, 1898, ser. 4, vol. 2, p. 99; True, Proc. U. S. Nat. Mus., 1898, vol. 21, p. 634.
1822. *Balaena boops*, Albers, Icon. Anat., pl. 1 (in part).
1828. *Balaena minimus borealis* Knox, Cat. Prep. Whale, p. 14.
1829. *Balaena borealis ?γ rostrata* Fischer, Synopsis Mammalium, p. 525.
1836. *Rorqualus boops* F. Cuvier, Hist. Nat. des Cétacés, p. 321, pl. 20 (in part).
1837. *Balaena minima* Rapp, Die Cetaceen zoologisch-anat. dargestellt. Stuttgart and Tübingen, p. 52.
1837. *Rorqualus minor* Jardine, Naturalist's Library, Mammalia, vol. 6, p. 142, pl. 7.
1842. *Rorqualus rostratus* DeKay, Zool. New York, Mammalia, p. 130, pl. 30, fig. 1.
1843. *Balaenoptera boops* Newman, Zoologist, vol. 1, p. 33, fig. (in part).
1845. *Balaenoptera eschrichtii* Rasch, Nyt Mag. for Naturvidensk., vol. 4, p. 123.
1846. *Balaenoptera rostrata* Gray, Zool. Voyage Erebus and Terror, Mammalia, p. 50.
1846. *Balaenoptera physalus* Gray, Zool. Voy. Erebus and Terror, Mammalia, p. 18 (in part).
1849. *Pterobalaena minor* Eschricht, Unters. über nord. Wallthiere, p. 169.
1849. *Pterobalaena minor groenlandica* and *bergensis* Eschricht, K. Dansk. Vid. Selsk. Skrifter, ser. 5, vol. 1, p. 109.
1864. *Balaenoptera minima* Flower, Proc. Zool. Soc. London, p. 418.
1866. *Balaenoptera microcephala* Gray (ex Holboell MS.), Cat. Seals and Whales British Mus., ed. 2, p. 188.
1866. *Pterobalaena prostrata* Gray, Cat. Seals and Whales British Mus., ed. 2, p. 188 (attributed to Van Beneden, 1861, in error).
1868. *Agaphelus gibbosus* Cope, Proc. Acad. Nat. Sci. Phila., pp. 159, 224.
1868. *Balaena gibbosa* Cope, Proc. Acad. Nat. Sci. Phila., p. 159 (in part).
1877. *Sibbaldius mondinii* Capellini, Mem. Accad. Sci. Bologna, ser. 3, vol. 7, p. 423.
1898. *Balaenoptera mondini* Trouessart, Cat. Mamm., p. 1078 (not Gervais, Journal de Zool., vol. 6, p. 167).

History and Nomenclature.

No doubt the Little Piked Whale was well known to the Icelandic and Norse fishermen long before naturalists became familiar with it. In an ancient Norse manuscript called the Royal Mirror (Speculum regale or Königsspiegel), and believed to have been produced about the year 1280, mention is made of sundry whales and large fish, which Guldberg (1904) has attempted to identify. One of these, the "Geirhval," is believed by one commentator to be the present species, but of this there can be no certainty, and Guldberg does not vouchsafe an

PLATE 14.

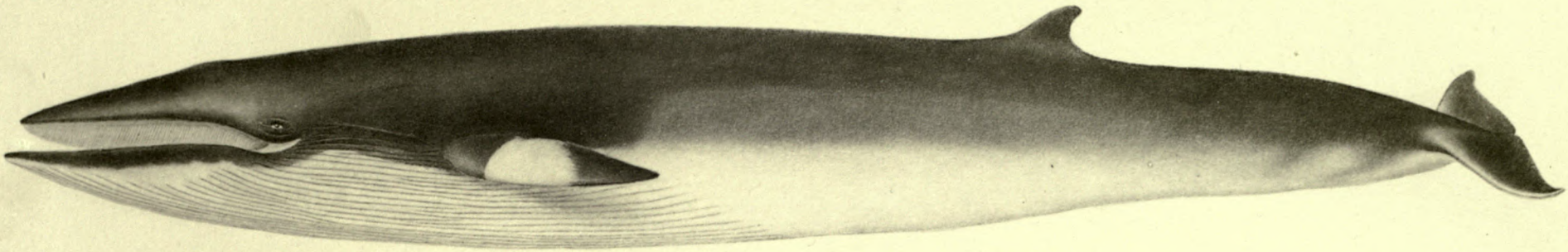
Little Piked Whale (*Balaenoptera acuto-rostrata*). Drawn by J. Henry Blake from the specimen taken at Provincetown, Mass., August 14, 1910, shortly after its capture.

Fig. 1. Side view, drawn to scale.

Fig. 2. Under side of the flukes, showing the dark posterior edging.

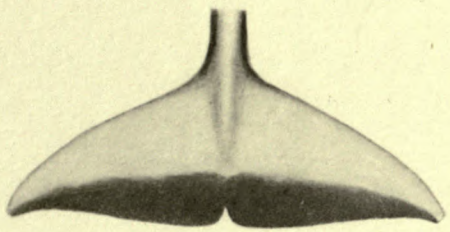
Fig. 3. The left pectoral flipper to show the color of upper surface. At the base the white area is sharply marked off but at the outer part it merges more gradually into the blackish tip.

Fig. 4. Upper side of the flukes.



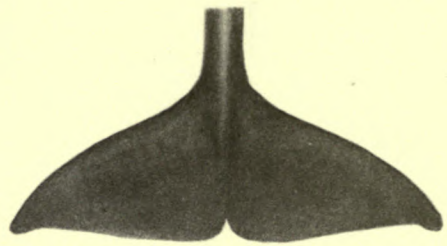
1

2ft.



2

3



4

LITTLE PIKED WHALE.

HELIOTYPE CO., BOSTON

UNIV. OF
CALIFORNIA

opinion. Linné himself had no knowledge of it, nor was it until 1780, when Fabricius's Fauna Groenlandica appeared, that it was characterized under the name of *Balaena rostrata*. Fabricius describes its small size, whitish whalebone, and even the pinkish tinge to the white of the belly and throat, but curiously, he makes no mention of the very conspicuous white mark on the pectoral limb. But Fabricius in calling it *Balaena rostrata* or beaked whale, did not know that the species to which this name had been applied by Müller in 1776, was not a whalebone whale, but a ziphioid — the Bottle-nosed Whale (Hyperoodon). In 1787, the English anatomist Hunter gave some account of his dissection of a Little Piked Whale killed in the North Sea, but it was not till 1803 that a tenable specific name was given it by Lacépède —*acuto-rostrata*, in reference to its pointed head, of which, however, his conception, drawn from descriptions and figures, was rather exaggerated. He placed the species in his genus Balaenoptera, from which it was later removed by Fischer in 1829, who in his compilation of the species of mammals then known, made it with some question, a variety of his "*Balaena borealis*," (*Balaena borealis ? γ rostrata*). Cuvier in 1836, erected the genus Rorqualus, and under *R. boops* included this whale. In 1837, Jardine corrected this to *Rorqualus minor* and DeKay, in 1842, following Cuvier's use of the generic term, again applied Fabricius's specific name in the combination *Rorqualus rostratus*. Gray, in 1846, used the name in combination with Lacépède's genus Balaenoptera, and he has been followed by many later writers. Three years afterward, Eschricht included it in his genus Pterobalaena, now recognized as a synonym of Balaenoptera, and revived "*minor*" as the specific name.

A specimen from Sweden was described in 1845 by Rasch under the new name *Balaenoptera eschrichtii*, but the characters claimed were not of specific value.

Still another combination, *Balaenoptera minima*, was proposed by Flower in 1864, reviving Knox's *Balaena minima*, a name overlooked by most systematists, as it appeared in trinomial form in a separately published paper in 1828.

Cope's apocryphal species, *Balaena gibbosa*, or as he in the same paper proposed to call it, *Agaphelus gibbosus*, appears to have been in part at least, this same species (see True, 1904, p. 105). The genus Agaphelus, however, seems to have been founded on a misconception and is no longer recognized.

In 1877, Capellini, an Italian naturalist, published an account of a specimen of the Little Piked Whale stranded on the Italian coast of the Adriatic, giving it the new name *Sibbaldius mondinii*, which Trouessart has corrected to *Balaenoptera mondini*. This was relegated to the synonymy a few years later. Finally Thomas and True, in 1898, both called formal attention to the fact that *Balaenoptera acuto-rostrata* of Lacépède is the correct systematic name for the species. Whether or not the representatives of the Little Piked Whale in the Southern and the Pacific Oceans are identical with the North Atlantic species, it is as yet impossible to tell with certainty, though the probabilities are that they are not specifically different. Until

this can be settled through a comparison of specimens these nominal species must continue to be recognized, and their synonymy is therefore not here included.

The type locality as given by Lacépède, is "aux environs de la rade de Cherbourg," on the Atlantic coast of France.

Vernacular Names.

In the books, this species is usually called the Pike-headed Whale or Little Piked Whale. Under the former name Pennant in his British Zoology included both this and the Common Finback, though he himself recognized that some confusion existed. The origin of the name, he says, "is from the shape of its nose, which *Dale* observes, 'is like that of the Pike fish.'" But the term 'pike' as used by the Scotch fisherfolk, was applied to the high and pointed dorsal fin, whence the name 'piked whales' by which the species of Balaenoptera are sometimes collectively designated. It seems originally to have meant the sharply pointed blade of the foot-soldier's pike or heavy thrusting spear of mediaeval days. 'Pike-headed' would thus mean sharp-headed like the conventional spear point. This is the French rendering, and the species is usually called by French writers 'La Balénoptère à museau pointu.' The name 'Little Piked Whale' on the other hand means merely the little whale with a dorsal fin or 'pike.' Similarly the terms 'Little Finner' and 'Lesser Rorqual' signify that it is a smaller representative of the Big Finner or Common Finback (or Rorqual). Since the Pollack Whale is also called Lesser Rorqual it is more appropriate that the present species should be designated as Least Rorqual, following True (1898), since it is the smallest of living species of this genus. Among German-speaking people it is called Zwergwal, that is, Dwarf Whale on account of its small size. To the Danes and Norse it is Vaagehval or Bay whale, because of its habit of coming close in near the land among the fiords. The Swedish term Vikarehval or Vikhval has the same significance. Van Beneden says that the people of Norway sometimes speak of it as the Summer Whale, as it is more often seen, in the northern part of that country at least, during the warm season.

Another colloquial term used by the Norse, is Minkie's Hval (*i. e.*, Minkie's Whale). Millais (1906, p. 279) gives the origin of this. "Minkie was a Norwegian seaman who was always calling 'Hval' at whatever backfin he saw. He is now regarded as the type of the 'tenderfoot' at sea. Norwegians often refer to any small whale with some contempt or amusement as a 'Minkie' or 'Minkie's hval.'"

On our own coasts, and in Newfoundland and Labrador it is almost universally called Grampus Whale or merely 'Grampus.' The latter term is more properly applied to the large porpoise, *Grampus griseus*, though by fishermen generally it is used to denote a cetacean of medium size, which, of course, is more nearly its original meaning, since the word is from the French 'grand poisson' — big fish. Our New England fishermen are wont to consider this small whalebone whale as merely a 'young Finback' though the more observant of them

sometimes admit, on viewing a stranded specimen, that "there *is* something strange about her at that" (to a whaleman a whale is always "she" or "her").

The Greenland Eskimos call it 'Tikagulik,' and curiously, the Alaskan Eskimos have a nearly identical term, 'Tschikagulik' for the representative of the species in Bering Strait (van Beneden, 1887).

Description.

Form.— In general the outline of the body resembles that of the Finback, but the posterior portion is less attenuated, and the form is somewhat stouter. The snout and jaws are rather sharply pointed, though not excessively so. The dorsal fin is prominent, high and falcate. The caudal fin is like that of the other members of the genus.

The eye is exactly over the angle of the mouth. From the angle runs a groove or gutter, which is continued a short distance behind the eye and ends indefinitely. The ear is a small opening the size of a pin head between the eye and the pectoral.

Plicae.— The throat folds in a Provincetown specimen I examined in 1910, were, counting from the mid-line to the pectoral, twenty-six, or about fifty-two from side to side. Mr. J. Henry Blake noted fifty in a Provincetown specimen.

Color.— A Provincetown specimen which I examined in a fairly fresh condition, about two days after its death, was a beautiful blue gray on the parts of the back which had not been exposed to the sun. This color covered the sides and entire upper parts, and extended forward on to the border of the lower lip and below the pectoral as far as the fifth plication. The entire throat and the belly below these points were ivory white over an area that narrowed towards the tail but included the ventral part of the caudal peduncle or 'small' and all but the posterior fourth of the under side of the flukes. Here the color changed to grayish and then black, forming a dark border to this member. In life the white ventral area has a distinct pinkish tinge, but this is evanescent, and quickly disappears after death. It is represented in Bocourt's figure (Gervais, 1871, pl. 3) of a specimen stranded on the French coast. A very characteristic marking of this whale is the broad white band across the pectoral limb. In the specimen here described, the base of the pectoral was colored dark blue gray like the back, but at a distance of 50 millimeters from the body, this color ended abruptly with a sharply defined limit, and gave place to a clear white band across the entire breadth of the limb. This band extended on the upper surface for some 260 millimeters, then became clouded and shaded into the blackish tip, which therefore comprised nearly the terminal half of the pectoral. The under surface of the limb hardly differed in pattern and color. Turner (1892, p. 49) records that in a specimen from Granton, British Isles, there were black blotches on the white area of the limb, but this is unusual apparently. The tongue is light yellow.

Hair.— The number of bristles on the snout appears to be greatly reduced in this whale

over the number occurring in the larger species of the genus. Japha (1911) has described and figured their arrangement as found in a foetus some 700 mm. long. There is but a single row on each side of the snout, and this seems to correspond to the inner of the two rows in the Common Finback and the Blue Whale. These two rows comprise five bristles each, arranged on a slightly S-shaped line, the posteriormost bristle about on a level with the middle of the blowholes, and set in nearer them than the bristle next in front. In a somewhat smaller foetus Japha found but four on each side, and this agrees with the count in a specimen examined by van Beneden (1887). On the lower jaw the arrangement is similar to that in the larger Balaenopterae. There are two vertical rows, parallel to each other, at the point of the jaw but the actual number of hairs in each row he does not mention, though to judge from his figure, there are six in each. The true number is doubtless more for Knox (1833–4) found eight distinct bristles in each of the two perpendicular rows of a young specimen. In addition, Japha mentions other smaller scattered hairs at the symphysis, making in all some thirty at the tip of the jaw. The lateral row on the side of each lower lip consists of six or seven bristles. The vibrissal hairs thus total about 38 or 39.

External Measurements of

	1 Provincetown, Mass.				2 Provincetown, Mass.			
	Ft.	In.	Meters	%	Ft.	In.	Meters	%
Tip of snout to notch of flukes	14	5½	4.41	100	14	6	4.42	100
" " " " angle of mouth	.....		.....	.....	.....		.....	.....
" " " " anterior corner of eye	2	9	0.84	19.04	.....		.....	.....
" " " " posterior margin of blowholes	.....		.....	.....	2	4	0.71	16.08
" " " " anterior " " "	2	4	0.71	16.13	.....		.....	.....
Eye to anterior insertion of pectoral	1	9	0.53	12.10	1	9	0.53	12.06
Length of eye opening	.....		.....	.....	0	2¼	0.07	0.01
Length of pectoral fin from anterior insertion to tip	2	0	0.61	13.77	2	4	0.71	16.08
Greatest width of pectoral	0	6½	0.16	3.72	0	7	0.17	4.02
Width of insertion of pectoral	0	11	0.28	6.34	0	10	0.25	5.72
Length of base of dorsal fin	.....		.....	.....	0	11	0.28	6.32
" " anterior edge of dorsal fin	.....		.....	.....	.....		.....	.....
Greatest height posteriorly of dorsal fin	0	5½	0.14	3.17	0	7	0.17	4.02
Posterior base of dorsal fin to notch of flukes	.....		.....	.....	.....		.....	.....
Anus to notch of flukes ventrally	.....		.....	.....	.....		.....	.....
Anus to navel	.....		.....	.....	.....		.....	.....
Length of mammary slit	.....		.....	.....	.....		.....	.....
Width from tip to tip of flukes	3	7	1.09	24.71	4	2	1.27	28.73
Width from tip of fluke to median notch	.....		.....	.....	.....		.....	.....
Anterior edge of fluke from insertion to tip	2	0	0.61	13.60	.....		.....	.....
Tip of snout to pectoral	4	7	1.40	31.40	.....		.....	.....
" " " " base of dorsal fin	.....		.....	.....	.....		.....	.....
Eye to ear opening	.....		.....	.....	0	9¼	0.23	5.31
Greatest girth	.....		.....	.....	7	3	2.21	50

In an adult whale 28 feet long, Turner (1892, p. 48) was unable to discover any hairs on either upper or lower jaw, so that it may be they drop out or wear down with age.

Baleen.— The whalebone plates of the external rank numbered about 316 on each side in a Provincetown specimen I examined in 1910. Collett (1886) gives the number as about 325. In color they are usually described as entirely yellowish white, but in the above specimen there was a basal band of a purplish tinge due to a veining of that color, and this was most conspicuous in an area about 15 mm. broad and the same distance from the base of each plate. The longest plate of baleen in the 15-foot whale was about 108 mm., (4 inches) but in an adult whale the largest are about 200 mm. (8 inches) on the exterior edge, not including the frayed bristles.

External Measurements.—The following table gives the comparative dimensions of five New England specimens, all of which, however, are immature. I have therefore added the dimensions of an adult specimen taken at Granton, Scotland, as recorded by Turner (1892). The percentage that each dimension bears to the total length of the specimen is given in the third column for each individual. In this table, Nos. 1, 2, and 5 were measured by Mr. J. H. Blake, No. 3 by myself, and No. 4 by J. P. Thompson (the last reprodueed from True's monograph of 1904.)

Balaenoptera acuto-rostrata.

3 South Truro, Mass.				4 Portland, Me.				5 Provincetown, Mass.				6 Granton, Scotland			
Ft.	In.	Meters	%	Ft.	In.	Meters	%	Ft.	In.	Meters	%	Ft.	In.	Meters	%
15	3 9/16	3.755	100	15	4	4.67	100	16	7	5.05	100	27	10½	8.75	100
2	9½	0.850	22.6	2	8	0.82	17.39	.....	.....	.....		5	½	1.54	18.08
2	9½	0.850	22.6	.....	.....	.....		3	2	0.97	19.09				
2	5	0.760	20.2	.....	.....	.....		2	8	0.81	16.08				
.....	.....	.....		2	6	0.76	16.30	2	2	0.66	13.06	3	9	1.14	13.45
1	11¼	0.590	15.6	.....	.....	.....		1	11	0.58	11.55				
0	1¾	0.045	1.2	.....	.....	.....		0	2½	0.05	1.06				
2	3¾	0.705	18.7	2	2	0.66	14.12	2	4	0.71	14.08	4	4	1.32	15.54
0	6.7	0.170	4.5	0	7	0.18	3.80	0	7½	0.19	3.76	1	1	0.33	3.88
0	9.45	0.240	6.3	.....	.....	.....		1	0	0.30	6.03				
1	0.3	0.310	8.2	.....	.....	.....		.....	.....	.....		1	7	0.48	5.68
0	11 1/16	0.280	7.4	1	0	0.30	6.52								
0	7.5	0.190	5.0		8±	0.20	4.34	0	9	0.23	4.57	1	0	0.30	3.58
4	7⅛	1.400	37.2	5	4	1.63	34.78	.....	.....	.....		7	0	2.13	25.11
4	0	1.200	31.9	4	3	1.30	27.71	.....	.....	.....		7	2	2.18	25.71
3	1½	0.950	25.3												
0	3¼	0.082	2.1												
4	0 7/16	1.230	32.7	4	2	1.27	27.17	4	0	1.22	24.12	7	4	2.23	26.30
2	1	0.635	16.9	.....	.....	.....		2	0	0.61	12.06				
2	3⅛	0.690	18.3												
.....	.....	.....		.....	.....	.....		4	11	1.50	29.64				
.....	.....	.....		.....	.....	.....		11	0	3.35	66.33	18	2	5.54	65.17
.....	.....	.....		.....	.....	.....		.....	.....	.....		1	3	0.38	4.48
.....	.....	.....		9±	0	2.74	58.69								

Musculature.— The muscular anatomy of this whale has been carefully described by Carte and Macalister (1868). The simplicity of structure is rather striking, yet amply serves the animal's need. Owing to the loss of the posterior limbs there are no hind-leg muscles, while those of the fore limb are much reduced in number. No mention is made by these authors of the great *panniculus*, which in the Finback and the Blue Whale is so prominent. No doubt, however, this is present, and, as in the two species just mentioned, serves to contract the throat folds. The other chief muscles of the body I have tabulated below, giving for each its name, its origin, and its place of insertion as described by the above authors.

Muscles of Head.

a. Muscles opening and closing nostrils.

Name.	*Origin.*	*Insertion.*
Dilator naris	Upper border of maxillary from tip to malar	Outer lip of nares and median raphe of snout
Retractor alae nasi	Antero-external portion of frontal	Cartilaginous lateral and posterior lip of nares
Constrictor naris	Anterior edge of temporal fossa	Outer lip of nares and median raphe of snout
Depressor alae nasi	Intermaxillary and median raphe of snout	Outer border of nares

b. Muscles of the jaws.

Mylohyoid	Lower border of jaw to its angle	Two muscles of opposite sides join medially
Digastric	Mastoid process of squamosal and sulcus behind	Lower posterior surface of angle of jaw
Temporalis	Entire temporal fossa from orbit to glenoid	By tendon into coronoid process of jaw
Masseter	(1) Lower border of orbit; (2) margin of glenoid	(1) Posterior part of angle of jaw; (2) in front of angle
Pterygoideus externus	Outer surface of pterygoid plate	Inner border of lower jaw near angle
Pterygoideus internus	Wanting	Wanting

c. Muscles of the tongue.

Genioglossus	Inner border of apex of jaw	Deep surface of mucous membrane, center of tongue
Lingualis	Longitudinal and transverse fibers	Forming the mass of the tongue
Hyoglossus	Great cornu of hyoid bone	Center length of side of tongue
Palatoglossus	Median line of soft palate	Upper surface of tongue
Styloglossus	Outer base of styloid corner of hyoid bone	Posterior half of side of tongue

Muscles of the Neck.

Name.	*Origin.*	*Insertion.*
Mastohumeral	Transverse processes of anterior cervicals and paramastoid process	Tendinous, anterior inner part of humerus
Longus colli	3 heads: (1) ventral surface of cervicals 3–7 and dorsals 1, 2; (2) outer part of first rib; (3) posterior part of 3 first ribs	Basilar process of occipital bone and transverse processes of anterior cervicals
Trachelomastoid	2 heads: (1) transverse process of first dorsal (2) centra of posterior 3 or 4 cervicals	Mastoid process of squamosal

Muscles of the Trunk.

a. Muscles of thorax.

Pectoralis major	Under side of sternum and five first sternal ribs	Tendinous, front of humerus head
Pectoralis minor	Lacking	Lacking
Latissimus dorsi	Spines of all dorsals and few anterior lumbar vertebrae	Inner lower edge of humerus
Rhomboideus	Same, by this aponeurosis	Posterior edge of scapula
Serratus magnus	(1) 8 posterior ribs and aponeurosis of abdomen;	Posterior edge of scapula, just above angle
	(2) a flat slip from second rib	Same
Levator anguli scapulae	Pyramidal, from transverse process of 7th cervical	Cervical angle of scapula
Intercostales	20 on each side in two sets; (1) external;	(2) internal, connecting ribs
Omohyoid	Coracoid process and anterior edge of scapula	Posterior cornu of hyoid bone
Scalenus anticus	Sternal end of first rib	Transverse processes of anterior cervicals
Sternomastoid	(1) mid-line of sternum, and ends of ribs 1 and 2 (2) external part of first rib	By tendon into mastoid process of squamosal
Sternohyoid	Upper border of sternum	Lower edge of body of hyoid bone
Sternothyroid	Wanting	Wanting

b. Muscles of abdomen and tail.

Obliquus externus	By slips from 8 last ribs	By a large tendinous sheet into linea alba
Obliquus internus	Tendinous from lumbar fascia	Linea alba and cartilaginous ends of 8 or 9 last ribs
Transversalis abdominis	Fleshy from lumbar fascia to 10th rib	Tendinous into linea alba
Rectus abdominis	Tendinous from 3 or 4 anterior chevron bones	By tendinous expansion into 2d to 6th ribs

Name.	*Origin.*	*Insertion.*
Longissimus dorsi	Tendinous from neural arches of caudals to tip of tail	External ridge of occipital bone
Sacrolumbalis and splenius capitis	Same origin, external to last, small	Posterior portion of mastoid process
Levator caudae	Upper surface of transverse processes of lumbars and anterior caudals	By 8 tendons into sides of last caudals and flukes
Depressor caudae major	Lower surface of transverse processes and centra of all lumbars and caudals and chevron bones	Lower surfaces and sides of caudal vertebrae and flukes
Depressor caudae minor	Below and external to last, from lower surfaces of caudals	Posteriormost caudals and flukes

Shoulder and Limb Muscles.

Deltoid	Upper outer half of scapula	By tendon into head of humerus
Teres major	Lower border of scapula	Anterior and inner surface of neck of humerus
Supraspinatus	Acromion and vertebral border of scapula under deltoid	Ridge on outer side of humerus head
Infraspinatus	Lower half of top of scapula	Upper outer part of humerus head
Subscapularis	Entire inner surface of scapula	Tendinous, into front of humerus head
Coracobrachialis	Apex and front of coracoid process	Anterior and inner part of humerus head
Flexors of forearm lacking		
Triceps	Three heads: (1) inner neck of scapula	End of cartilaginous olecranon
	(2) middle of upper and posterior edge of humerus	Just anterior to (1)
	(3) posterior edge of humerus below head	Anteriormost part of cartilaginous olecranon
Extensor digitorum communis	Heads of radius and ulna, and interosseous space	By 4 tendons, 1 to each digit
Flexor carpi radialis	Anterior surface of humeral end of radius	By tendon into base of metacarpal 1
Flexor digitorum communis	Olecranon and inner edge of humerus	By 4 tendons, one to each digit
Palmaris longus	Delicate, from cartilaginous olecranon	Metacarpal of digit 4 and palmar fascia
Flexor carpi ulnaris	Strongest, inner surface of olecranon	Inner side of metacarpal 4

Four sets of muscles operate to open and close the nostrils. Of these the most superficial (*dilator naris*) extends along the whole side of the snout and by its contraction pulls the nostril open. A deeper muscle draws it together again. The jaw muscles are poorly developed in comparison with those of a carnivorous land mammal, but suffice to open and close the great mouth. The broad mylohyoid serves by its expansion and contraction to extend and compress the bag-like throat so that large quantities of water containing the whale's food are engulfed within the mouth, when by the contraction of the bag, and the raising of the tongue, the water is expelled along the great gutters at the corners of the mouth, leaving the food against the tongue and the sieve of frayed bristles of the whalebone. The most notable of the

body muscles are the enormous masses that raise or lower the tail, and serve to propel the animal. Their great proportionate size would be apparent if we were to conceive, for example, of a dog with a tail as thick as its body instead of the usual slender tapering tail. As the old college song put it, "the tail would waggle the dog," and so it actually is with the whale, for the enormous caudal muscles with their powerful sinews, drive the huge body through the water. The propelling motion is an up-and-down rather than a sidewise movement as in case of fishes. The muscles of the fore limb are greatly reduced and consist chiefly of shoulder muscles which insert upon the fore arm and humerus and serve to move the paddle or pectoral limb. The shifting of the acromion and the scapular ridge to the front edge of the shoulder blade has decreased the extent of the *supraspinatus*. But this is in part compensated by the size of the acromion and coracoid process. In the marsupials a shift of the scapular ridge to the anterior edge of the shoulder blade has resulted in a sort of rotation of the supraspinal muscles to the inner side of the scapula, but in Cetacea the *subscapularis* occupies the whole inner face of that bone. No doubt this arrangement in the whales facilitates the forward motion of the flipper, which, when at rest, is directed posteriorly. The extremely poor development of the hand muscles is a result of their loss of function except as an aid in stiffening the paddle.

Visceral Anatomy.—In their work on the anatomy of this whale, Carte and Macalister (1868) describe the mucous membrane lining the mouth as thrown into longitudinal folds at the inner side of the lower lip, as a sort of continuation of the throat folds, and so adding to the expansibility of the great throat pouch. The upper jaw is shorter than the lower and fits into it when the mouth is closed. In feeding, the throat folds expand to engulf a great quantity of water with the living food, when by closing the mouth and contracting the throat folds, the water is expressed through the plates of baleen, and the food is retained by the thickly matted fibers of their inner edges, whence by the action of the tongue it passes into the gullet. No trace of salivary ducts or functional salivary glands could be ascertained, though the above authors discovered among the muscles of the jaw a small glandular mass which may have represented the vestiges of salivary glands. Owing to the nature of the whale's food and its manner of feeding, such structures are doubtless not needed. The tongue is fixed to the floor of the mouth and as seen casually in a dead specimen hauled out on shore, is hardly distinct from the general mass of the throat muscles. It shows on close inspection both filiform and fungiform papillae, the latter particularly at the sides. At the back of the mouth a curious hood-like fold of mucous membrane is present, the cavity of which is directed backward. During the act of swallowing, this hood completely closes over the opening of the air passage to the lungs, and so effectually excludes water from them and prevents the escape of air as well. The diameter of the gullet in the 14-foot whale dissected by these two anatomists was hardly more than one and a half inches, and its length was some eighteen inches. Its lining is thrown into low ridges running lengthwise which give it some power of distention. Five distinct stomach chambers are

described by Carte and Macalister. The first is somewhat oblong in shape, with a strong and firm wall, whose inner side is covered with transverse rugae, running from right to left, with smaller secondary ridges. This communicates by a narrow aperture with the second cavity which is largest of all, with thinner and more prominent rugae on its inner surface. The third cavity is the smallest of all, and opens into the fourth through a curious valvular aperture. The fourth division of the stomach is somewhat pear-shaped, and its lining smooth, while the fifth is slightly smaller, with glandular walls, and communicates with the duodenum by a small pylorus guarded by a sphincter muscle. Turner (1892) corroborates Carte and Macalister's description of the stomach as consisting of five separate compartments of which the first and second are the largest and subequal, the third very small, the fourth and fifth together about the size of the first. The third compartment is hardly apparent from the exterior. Turner concludes that the first large compartment is a large paunch, or enlargement of the oesophagus, serving as a sort of receptacle for the masses of food taken in; the second compartment, as those succeeding it, are lined with reticulated mucous membrane, so that they are the true digestive parts of the organ. The hepatic and pancreatic ducts unite at about half an inch before entering the peritoneal covering of the intestine, after which the conjoined duct runs obliquely some two inches between the coats of the intestine before opening under a little hood-like fold of mucous membrane about 6.5 inches below the pylorus. The small intestine measured about 81 feet in the 14-foot specimen, or about 5.8 times the length of the animal, and so longer in proportion than in the Finback. Peyer's glands were present both solitary and in scattered patches all through the ilium. A caecum about 8 inches long is described by Carte and Macalister, lying on the right side of the body. The large intestine was 3 feet 8 inches long.

The liver is divided above into a smaller right and a larger left portion. In ventral aspect the middle or Spigelian lobe of the liver appears. There is no gall bladder. The spleen is very small.

Skeleton. — The most noticeable differences shown by the skull, as compared with that of the Common Finback are the following. The rostrum or that portion in front of the small nasal bones is relatively very short and broad at base. Its sides are nearly straight, and they converge rapidly to a sharp peak. The nasal opening is wide, and the nasals are of characteristic shape — blunt and squarely truncate at the anterior free edge, narrowing regularly behind. The hinder margin of the broad frontal bone slopes to the rear instead of forward as in the Common Finback.

No adult skulls from the western Atlantic are available for measurement. True (1904) gives percentages of the lengths of sundry parts referred to its total length, for a Massachusetts skull, but other than this there are no published measurements of New England specimens. I have therefore appended a table giving various measurements of five New England

skulls of various ages all, however, immature (and unfortunately for the most part imperfect). In addition I have reduced these to percentages of *greatest breadth* of the respective skulls. The corresponding dimensions of a fine adult skull from Norway in the Museum of Comparative Zoölogy complete the series, and show the difference in proportions between immature and adult skulls.

The table brings out rather strikingly: (1) the relatively slight variation of the different general proportions in skulls of nearly the same size; (2) the considerable differences in the same proportions when immature and adult skulls are compared. The great constancy in the size of the tympanic bone, which in five skulls is of very nearly the same length, indicates that it attains its full size at an early age, and does not continue to grow with the rest of the skull. Since this very hard and loosely attached bone is often the only part of a whale skeleton preserved in fossiliferous deposits, it is obvious that its constancy in size and shape make it of much value in determining the species to which it belonged.

Vertebrae.— The vertebral column shows much reduction over that in the other species of the genus. The rib-bearing vertebrae are eleven, the lumbars twelve or thirteen, and the caudals from seventeen to twenty — a total varying from 46 to 50 if all the published formulae are to be regarded as correct. The usual formula is: C 7, D 11, L 12, Ca 18 = 48; this is the count in the Massachusetts skeleton in the U. S. National Museum. It is possible however, that one or two of the terminal caudals are often lost. A skeleton from Truro, Mass., now in the Museum of Comparative Zoölogy, has the following formula: C 7, D 11, L 12, Ca 20 = 50. The caudal vertebrae were very carefully dissected out by myself, and there is no question that this was the correct number for this individual. The only other case in which this number is recorded is that given by Sir William Turner for a Scotch specimen, *viz.*, C 7, D 11, L 13, Ca19 = 50. Fifty is no doubt the maximum number.

In marked contrast to the Common Finback the upper and lower transverse processes on each side of the third to fifth cervicals usually are not united at their outer extremities to enclose a vertebrarterial canal, but instead, those of the axis only are so united forming a closed ring. This is the condition in a skeleton (no. 7980) in the Museum of Comparative Zoölogy from Cape Cod and in a second from Massachusetts in the U. S. National Museum. In a third and younger specimen in the M. C. Z. collection (no. 8832 probably from Cape Cod) the arch is complete on the left side but not quite so on the right, though no doubt it would have closed later in life. In the third, fourth, and fifth cervicals the lower process (parapophysis) is longer than the upper (diapophysis). In the sixth, however, the upper is the longer, and in the seventh it is even more extended, with a strong downward curve. The lower process practically disappears with the seventh cervical, where it is reduced to a minute knob. In one specimen recorded from Europe, the processes of the fifth vertebra unite to form a ring, and three cases are recorded in which they are so united in the sixth vertebra.

Skull Measurements of Little Piked Whales.

	Provincetown Aug. 21, 1909 5228 B. S. N. H.		Provincetown 1463 B. S. N. H.		♀ Mass. 1248 M. C. Z.		South Truro, Mass. June 25, 1910 7980 M. C. Z.		Mass. Bay 1882 8831 M. C. Z.		Norway 7916 M. C. Z.	
	cm.	% of breadth	cm.	% of breadth	cm.	% of breadth	cm.	% of breadth	cm.	% of breadth	cm.	% of breadth
Greatest length (straight line)	—	—	—	—	96.0+	184.6	112.8	208.8	—	—	170.0	180.8
Length of maxillary (upper side; straight line)	—	—	—	—	70.0	135.0	72.0	133.3	79.0	114.4	122.5	130.3
" " intermaxillary (straight line)	—	—	—	—	—	—	64.0	118.4	—	—	125.5	133.5
" " lower jaw (straight line)	95.0	195.8	—	—	99.0	190.3	99.5	184.2	125.5	181.8	173.0	184.0
Greatest width across squamosals	48.5	100	49.2	100	52.0	100	54.0	100	69.0	100	94.0	100
" " of supraoccipital	38.4	79.1	36.0	73.1	36.2	69.6	37.5	69.4	51.3	74.3	65.5	69.6
" " at base of rostrum (just in front of zygomatic process of maxillary)	30.5	62.8	31.0	63.0	34.0	65.3	34.5	63.9	40.5	58.6	62.0	65.9
Greatest width across zygomatic processes of maxillaries	42.0±	82.4	44.0	89.4	46.0	88.4	46.0	85.1	57.0	82.6	86.5	92.0
Least width at vertex	13.0	26.8	14.0	28.4	15.0	28.8	12.0	22.2	13.1	19.2	22.0	23.4
Outer edge of orbital process of frontal	16.0	33.0	16.5	33.5	17.0	32.7	17.5	32.4	21.1	30.5	26.8	28.5
Inner border of orbital process of frontal	19.0	39.1	22.7	46.1	20.5	39.4	20.5	37.9	26.5	38.4	38.0	40.4
Nasals, median length	9.6	19.7	—	—	10.2	19.6	11.0±	20.3	—	—	17.0	18.0
" combined width anteriorly	5.5	11.3	—	—	7.6	14.6	—	—	—	—	11.0	11.7
Breadth across condyles	13.5	27.8	13.5	27.4	14.0	26.9	15.0	27.4	14.3	20.7	17.0	18.0
Anterior edge of supraoccipital to condyles in median line (straight)	29.0	59.7	31.0	63.0	29.0	55.7	30.5	56.4	38.2	55.3	42.0	44.6
Greatest length of palatal bones	21.5	44.3	22.8	46.3	22.7	43.6	25.0	42.3	30.5	44.2	39.1	41.5
" " " tympanic	8.0	16.5	8.5	17.4	7.9	15.1	8.4	15.5	—	—	8.0	8.5

The cervical vertebrae are practically free, though in some individuals fusion of the spines or the lateral processes takes place. Thus in the Massachusetts skeleton described by True (1904, p. 200) the neural arch of the third cervical is fused to the spine of the axis, and the same is true of the skeleton from Cape Cod (no. 7980) in the Museum of Comparative Zoölogy. The vertebral formulae of the three Massachusetts skeletons are

No.	*Cervicals.*	*Dorsals.*	*Lumbars.*	*Caudals.*	*Total.*
U. S. N. M. 20931	7	11	12	18	48
M. C. Z. 7980	7	11	12	20	50
M. C. Z. 8832	7	11	?13	?17 or 18	47 + (1 or 2)

In the last skeleton one or possibly two terminal vertebrae are to be added as the 47th though small is clearly not the last.

The "number of chevron bones in European specimens," says True (1904, p. 201), "is usually nine, but sometimes eight. The number in the Massachusetts specimen [from Harwichport, U. S. N. M. 20931] is nine." Eight are preserved with skeleton 8832 in the Museum of Comparative Zoölogy, probably from Massachusetts Bay. I believe that this number does not represent the true count. In the Cape Cod specimen (M. C. Z. 7980) I dissected these out with great care, and found nine V-shaped bones, as commonly recorded, but succeeding these, in the corresponding places between each two vertebrae, were four other chevrons consisting of small paired plates that had not united to form V's. The three last pairs were mostly cartilaginous, and so small as readily to escape notice, yet was their nature unmistakable. The total number of chevrons should thus be reckoned as *thirteen* in this specimen and no doubt four (or five) should be added in all cases where but nine (or eight) are recorded.

Ribs.— Eleven pairs of ribs is the normal number in this species and so far as I know, there have been no variations from this number recorded.

Sternum.— The sternum is commonly cross-shaped, with a longer 'handle' than in the other species of the genus. There appears to be slight variation in the outline of this bone, however, chiefly in the degree to which the arms of the cross are developed. The sternum figured by Carte and Macalister seems almost an oval. In the retention of a long posterior arm, the sternum of this whale is perhaps to be considered less reduced and so not so specialized, as compared with other large Balaenidae and Balaenopteridae.

Scapula.— In general the outline is much like that of the other members of the genus, but with the posterior border of the curve bending rather more sharply downward. Both acromion and coracoid are strongly developed. True has shown that the proportionate breadth of the scapula increases with age.

Hand.— The phalangeal bones of the 1910 Provincetown specimen (now in M. C. Z.) I dissected out with great care on one side and found them to be: I 4, II 8, IV 7, V 3. The Harwichport, Mass., skeleton at Washington is incomplete in respect to these bones. True

(1904, p. 204) has summarized the counts as recorded by several European observers, and the result indicates some variation, the extremes of which are: I 3–5, II 6–9, IV 5–8, V 3–4. The extreme numbers 9 for digit II and 8 for IV were recorded from embryos by Kükenthal. These counts are greater by one than recorded by other naturalists, and the same is true of Kükenthal's figures for *B. physalus*.

Pelvis.— In an adult of this species (28 feet long) Turner found the pelvic bones to be fully ossified, 8 and 8.5 inches long respectively, and of the usual form in the genus. He found no indication of a rudimentary femur, and concludes that the fibrous mass described by Perrin (1870) as possibly representing it, was merely a cross section of several tendons.

Appearance and Actions.

In 1906, during a cruise along the Labrador coast, I saw numbers of these small whales and became somewhat familiar with their appearance. On July 18th, opposite Rigolet, which is well within the estuary of Hamilton Inlet, there were half a dozen feeding a mile or less off shore. For some while as I watched them they circled about in a circumscribed area, associated in pairs which rose and dived in unison, to appear again after a short interval. They acted as if pursuing a school of fish, possibly capelin (Mallotus). On coming to the surface, they 'blew,' with a sound distinctly audible at near a mile distant, yet rarely was there a visible spout. Sometimes, however, a short column of spray was seen, a result perhaps of the whale's breathing before reaching the surface, and so forcing up a small amount of water. Usually these whales rise to blow five times in succession, though I have counted as many as eight successive breathings, and there may be three or only one. Five seemed the usual number when undisturbed. The back surges to the surface immediately after exhaling, and the high curved dorsal fin follows at once, without the slight interval noticeable in the Common Finback and the Blue Whales, whose great length of back must first reach the surface before the dorsal fin appears. The tail is not shown as the whale settles in the water, curves the body slightly downward and dives beneath the surface. In feeding, the movements seemed leisurely and unhurried. On July 21st, however, as the steamer was near shore between Hopedale and Double Island, we witnessed an unusual display of exuberant spirits, when a whale of this species appeared off the bow 'breeching' — or leaping clear of the water. Five times it shot above the surface, belly uppermost, clearing the water beautifully, and with body arched slightly backward, fell on its back with a great splash. At each leap it came nearer our vessel, and as it cleared the surface the beautiful pinkish tint of the white belly was clearly perceived, and the white band on the flipper was markedly conspicuous. Finally its last leap brought it very near, when it dived, came to the surface for a normal 'blow' and passed far to port before again rising for breath. We saw many more of these little whales among the bays

and fiords of this rocky coast, but no other was ever seen to leap out of water. At Makkovik Island one was sighted near the edge of the pack ice. Near Hopedale Harbor a pair and later a single one rose to spout, and eight single ones between Fanny's Harbor and Nain, with pack ice constantly near. On the return the following day, two pairs and eight singles were seen, and off Cape Harrison a lone one close in shore, that in diving turned on its side and showed its white wrist band. This last individual several times shot up a column of spray when it rose to breathe, but this was probably in part water carried up with the breath, for the surface was very rough at the time. Ordinarily no 'spout' is visible even in the Labrador waters because, no doubt, on account of the comparatively small size of the whale and the slight depth to which it dives, the air in the lungs is not under such compression and is not expelled with such great force as in the larger species. For as suggested by Racovitza, it is probably the sudden and great expansion of the moisture-charged breath that cools it sufficiently to cause the condensation of the vapor.

Probably there is a slight migratory movement of these whales in summer, for they follow the open water as the ice goes out, seemingly in pursuit of the shoals of fish that come in shore. On the Norwegian coast it is called the Summer Whale since it appears more frequently at that season. In Perley's Report on the Sea and River Fisheries of New Brunswick, 1852, it is said that the Gaspé fishermen do not commence pursuit of the Humpback until the appearance about the middle of June of a smaller species (doubtless the Little Piked Whale) which swims too fast to be easily harpooned, and besides is not worth the trouble. This would imply that these whales are not present in the Bay of St. Lawrence in such numbers in winter, when the gulf is choked with ice. Brown (1868) says that in Davis Strait and Baffin's Bay it is a summer visitor only, and that even in southern Greenland it is rarely seen in winter.

From the observations recounted above, it seems that this whale is less social than the Common Finback, and is usually seen singly or in pairs. At times, however, as when attracted by a school of fish, several may congregate in the same place.

Food.

Exact observations as to the food of this Rorqual are disappointingly few, but it seems to be a fish-eater to a large extent, though no doubt the diet is occasionally varied with free-swimming crustaceans. Flower (1864, p. 254) mentions a specimen the stomach of which contained the remains of numerous fish of considerable size. The identity of the fish is uncertain, though his informant believed them to be cod. Guldberg (1885) says, in speaking of this whale that it follows the schools of herring with the Common Finback. Undoubtedly it feeds largely on this fish, and, on the Labrador coast it probably pursues the capelin (Mallotus) as it is known to do in Greenland, following it in among the bays and fiords. So abundant

are the capelin in the northern waters, when they come in shore to spawn that quantities may easily be dipped up with a net. The cod feed largely on capelin so it may be that the whale is really pursuing these latter in company with the cod when it is believed to be feeding on cod. Carte and Macalister found nothing in the stomach of their specimen except what seemed to be the lens of a fish's eye. Hunter mentions finding in the stomach of one, the remains of sundry fish, including a dogfish.

On the New England coast herring probably form its chief food, and no doubt it was while in pursuit of these fish that several of those recorded were taken in fish traps.

Perrin found small pebbles in the stomach of the specimen described by him, but these may have come from the fish eaten by the whale.

Breeding Habits.

Of its breeding habits practically nothing is known. As with other whales, a single young at a birth is the rule. Specimens have been taken as small as nine or ten feet in length, which were probably newly born or at least but a few weeks old. Van Beneden (1869) records one of three meters taken on the coast of Brittany in February, 1861, and Knox speaks of one killed in the Firth of Forth in February, 1834, that was but ten feet long. These two were probably born sometime in early winter. Eschricht believes the period of gestation to be ten months, and says that the young whale at birth is nine feet long, or about a third to a fourth the length of the adult. A foetus of 8 feet 2 inches is mentioned as seen by Melchoir which must have been nearly mature (van Beneden, 1887). Guldberg (1886, p. 145) after reviewing all the evidence obtainable concludes that the period of gestation is about ten months, and that the young are born probably in November, December, or January. The new born young is about nine feet long.

Geographic Distribution.

In the North Atlantic the Least Rorqual seems to be found chiefly in the cooler waters to the northward of the warm Gulf Stream current. On the western side, it has been recorded as far south as New York and New Jersey, but is apparently rare below the latitude of Long Island. In the Gulf of St. Lawrence and along the east coast of Labrador it is common but in Davis Strait it is rare and only a few seem to reach Baffin's Bay. Brown (1868) says that the natives of the western shores of Davis Strait seldom recognized the figures of this species, but the people of south Greenland knew it well. Low (1906, p. 273) says it is unknown to the Eskimo of Baffin Island. Fabricius, in 1780, wrote that it was plentiful in summer among the bays of south Greenland, but in winter appeared to be rare. In the eastern Atlantic the Little Piked Whale is abundant along the Norwegian coasts, and in summer goes as far north

as Spitzbergen, following the open water. Scoresby (1820, vol. 1, p. 486) records a specimen killed there in 1813, the whalebone of which was "of a yellowish white colour, and semi-transparent, almost like lantern-horns." It is occasionally stranded on the shores of the British Isles, and on the French coast of the Bay of Biscay. Rarely it enters the Mediterranean Sea. A skeleton is preserved at Bologne said to belong to an individual killed in the Adriatic, and there are other Mediterranean records. The presence of this whale in the intertropical seas has not apparently been reported. A similar whale occurs, however, in the Southern Ocean and has been distinguished as *B. huttoni*, and another name, *B. davidsoni*, has been applied to whales of this type occurring in the North Pacific. Though the ranges of these three whales appear to be separated, their characters are not well ascertained and it is still uncertain whether the distinctions are truly of specific value. So far as observations show, it is distinctively a shore-frequenting whale, and seems to avoid the high seas.

Occurrence in New England Waters.

In his great work on the whalebone whales of the western North Atlantic, True (1904, pp. 193, 195) was able to adduce notes on but five individuals of this whale from this side of the ocean, and these all appertain to specimens taken within the New England limits. Yet it is probable that the species is rather more common than these few instances would imply. Indeed I have been able to increase this number considerably. The Little Piked Whale is not unknown to our fishermen, who either distinguish it as 'Grampus Whale' or regard it as merely a "young Finback." The former term is rightly applied to this species by Dr. J. A. Allen in his mammals of Massachusetts (1869), in quoting some general notes supplied by Capt. Nathan E. Atwood of Provincetown.

Below I have given all the instances known to me of the occurrence of this whale in New England.

1849.— What may from its small size, have been a whale of this species is thus recorded by the Nantucket Inquirer (vol. 29, no. 62, May 23, 1849): "The fishing schooner *Orleans*, Captain Tinker, towed into New London [May 15th], a dead whale, 18 or 20 feet long, found near Point Judith," Rhode Island.

1852.— The capture of a "young finback whale, thirty feet long," off Cape Elizabeth, Maine, is reported in the Nantucket Inquirer of October 9, 1852 (vol. 32, no. 117). This may possibly have been a Little Piked Whale, but there is no evidence other than its size.

1856.— A "small whale" that eventually yielded but three barrels of oil, was captured and killed in one of the herring weirs at Lubec, Maine, about the 20th of August (Nantucket Inquirer, vol. 36, no. 97, Aug. 22, 1856). Its small size raises a presumption that it may have been of this species.

1858.— In the Museum of the Boston Society of Natural History is the imperfect cranium of a small whale of this species, taken at Provincetown. It was received with the Wyman Collection, of which it was 1463. In the manuscript catalogue of this collection it is entered as a 'Grampus Whale' but nothing further is known of its history. From the dates of other entries in the catalogue it seems that it was probably received about the year 1858.

1867.— A whale twenty-five feet long was captured about August 20th, at the mouth of the Seconnet River, Rhode Island. It was one of three that "had been sporting about in the river." From its small size and the fact that the three were inshore, probably feeding in the estuary, these were probably the present species, but the evidence is of course inconclusive (see Nantucket Inquirer and Mirror, Aug. 24, 1867).

1873.— In the Museum of Comparative Zoölogy are pieces of the characteristic baleen and other fragments of a Little Piked Whale collected at Provincetown, August 15th, 1873, by Mr. J. Henry Blake. The specimens are labeled "young Finback." This is probably the whale of which the measurements were published by True (1904, p. 195) as supplied him by Mr. Blake.

1878.— A "small Finback Whale" is reported, "sporting in the waters off Surfside, Nantucket, the last of October (Nantucket Inquirer and Mirror, vol. 59, no. 18, Nov. 2, 1878) — possibly a Little Piked Whale. It stayed in the vicinity for several days.

1881.— According to Dr. F. W. True (1904, p. 193) an imperfect skull was dredged up near Pigeon Cove, Mass., in 1881, and sent to the U. S. National Museum, by Mr. Wm. H. Jackson. The specimen is number 23,025 U. S. N. M.

1882.— The skull of a fairly large though not full grown specimen, is in the Museum of Comparative Zoölogy, marked "Mass. Bay, summer of 1882, J. Henry Blake." What may be the spinal column and ribs of the same individual are also in the collection, unfortunately without indication of locality or collector. Mr. Blake at my request has searched his journal for a possible note of this specimen but without avail.

1883.— Dr. F. W. True (1904, p. 193) records "a skeleton 16 ft. 5½ in. long from off Monomoy Pt. Lighthouse, Harwichport, Massachusetts, in the U. S. National Museum" (no. 20,931) received in this year from the U. S. Fish Commission. Up to the year 1904 it was the only skeleton of the species known to be preserved from the American side of the Atlantic.

1887.— The Nantucket Journal (vol. 9, no. 40, June 30, 1887) records the capture of a "Grampus Whale," ten feet long and weighing seven or eight hundred pounds, near Smith's Point, Nantucket, about the last of June. It had become entangled in a blue-fish net and drowned. There can be little doubt that this refers to the Little Piked Whale, which is commonly called Grampus Whale by those fishermen who recognize it as distinct from the Finback.

The same journal (Nantucket Journal, vol. 9, no. 42, July 21, 1887) records the capture of a second "Grampus Whale" in the upper harbor near Wauwinet, Mass., about the 10th

of July. A boat's crew succeeded in harpooning the whale, and it towed the boat about for nearly an hour, before it was sufficiently exhausted to allow itself to be killed with an axe. It had been seen in the harbor for most of the day before the capture was undertaken. Its length is given as nine feet, hence nearly the size of the one caught off Nantucket shortly before.

Major E. A. Mearns sends me the account of the capture of a small whale that was supposed to have been a "young Finback," but was perhaps a Little Piked Whale. The incident occurred in Narragansett Bay, R. I., but the exact date is not available. By some curious accident, the whale in rising to the surface caught its head between the stern and the propellor blades of the Government steamer *Munroe* as it lay at the South Dock. In its struggles to free itself the whale nearly lifted the stern of the vessel out of water. The Captain, seeing that the whale was caught fast, turned on full steam in order to dislodge it. This had the desired result, but the swiftly revolving blades inflicted such injuries upon the whale's head that it rushed upon a shoal at the head of Brenton's Cove and became stranded. It was finally killed there by soldiers from Fort Adams, and after being exhibited at the Fort and in Newport, was condemned by the health authorities. It was said to have been a female, about thirty feet long.

1889.— A female, 22 feet, 8 inches long was captured near Quoddy Head Life Saving Station, Maine, September 6th, and reported to the Smithsonian Institution by Captain A. H. Myers, Keeper of the Station. It is recorded by Dr. F. W. True (1904, p. 193) who mentions that two photographs of it are likewise on file. It is apparently the largest specimen of which there is any accurate record, from the eastern coast of the United States.

It is odd that another small whale, probably of the same species, should have been killed at about the same time in Rhode Island waters. The circumstances were communicated by (then) Lieutenant Wirt Robinson to Major E. A. Mearns, to whom I am in turn indebted for the note. The whale was killed September 5th near Fort Adams, and was said to have been about 27 feet long with whalebone eight or ten inches long. Lieutenant Robinson spoke of another whale 30 to 32 feet long that was rammed by his launch in February 1900, and afterward ran aground at Fort Adams. There is nothing to indicate its identity, however.

1893.— In July of this year a female, 15 feet, 4 inches long, became entangled in the nets of the fishermen near Portland, Maine, and was exhibited in that city. Dr. F. W. True has published (1904) an account with the measurements of this specimen, as furnished him by Joseph P. Thompson, Esq., Vice-President of the Portland Society of Natural History.

1895.— What appears to have been a Little Piked Whale entered one of the fish weirs at Provincetown, about May 7th, and was at once dispatched by the owner. It is spoken of as "a young Finback about 25 feet long" and was estimated to yield not more than two barrels of oil (Nantucket Journal, vol. 17, no. 32, May 9, 1895).

1904.— A Finback Whale about 30 feet long was reported by the coast guards "dis-

porting in the water near the Maddequet Life Saving Station, Nantucket, within a stone's throw from shore" about the 10th of November (Nantucket Inquirer and Mirror, vol. 85, no. 22, Nov. 19, 1904). From its small size and its coming so close inshore, it may perhaps have been the present species.

1905.— About the 10th of March a specimen became stranded in Provincetown Harbor and was captured by men of the Life Saving Station. A highly colored account of the occurrence appeared in the Boston Sunday Post, March 26, 1905. The skeleton of this whale was secured for the U. S. National Museum.

What may have been an individual of the same species was reported to have run aground in shallow water in the western part of Provincetown Harbor about the first of February, where it was dispatched by men from the Wood End Life Saving Station (Nantucket Inquirer and Mirror, vol. 85, no. 32, Feb. 4, 1905). Its length was given as 25 or 30 feet, but apart from its small size there is no other evidence as to its identity.

1909.— A small specimen, measuring about $14\frac{1}{2}$ feet in length was taken in the fish traps at Provincetown on August 21st, and a cast of it secured by the Boston Society of Natural History. Later, it was partially embalmed and exhibited in Winthrop. The skull, slightly damaged, was eventually secured by the Society. I am indebted to Mr. J. Henry Blake for the measurements of this specimen.

1910.— On May 18th, a small specimen, measuring but $12\frac{1}{2}$ feet in length entered one of the fish traps at South Truro, Mass., and was killed by the fishermen when they visited the net in the morning. It was reported as a "baby Finback," but Mr. D. C. Stull of Provincetown, in response to my inquiries, has given me a brief account of its characteristic markings which leaves no doubt as to its identity. The carcass was later towed out to sea.

A second whale of this species, measuring 15 feet 3 inches in length, was caught in the same trap on the Truro shore, June 25th. I was informed of its capture by Mr. Stull and through his kindness was enabled to measure and photograph it at Provincetown three days later. The skeleton was secured for the Museum of Comparative Zoölogy. A view of the ventral surface of this whale is shown in Plate 13, fig. 2.

I am indebted to Mr. J. Henry Blake for the record of a third specimen which was killed at Provincetown on August 14th. A few days previously what was probably this individual entered a fish weir at the western end of Provincetown Harbor, but was turned out again by the fishermen. Shortly after it entered a weir in the eastern part of the Harbor and was killed with a knife. Mr. Blake has kindly given me the measurements he took of this whale, and from it he has also drawn the excellent figure here published (Plate 14).

1911.— What was undoubtedly a whale of this species was captured in one of the fish traps at Provincetown in June, 1911. As the fishermen could make no use of it they set it free again. Mr. J. Henry Blake, who reported to me this occurrence, adds that the men called it a "young Finback."

1913.— Some pieces of baleen of this species were picked up at Horseneck Beach, Barnstable, Mass., probably early this year or shortly previous. I am indebted to Mr. C. W. Johnson, who identified the specimens, for this information. No doubt they came from a whale that had been killed near that coast.

Little Piked Whale in New England Waters.

	Year	January	February	March	April	May	June	July	August	September	October	November	December
Point Judith, Rhode Island	1849	....	....	....	....	1							
Off Cape Elizabeth, Maine	1852	....	....	....	....	....	....	....	....	....	1		
Lubec, Maine	1856	....	....	....	....	....	....	....	1				
Provincetown, Mass.	1858												
Seconnet River, Rhode Island	1867	....	....	....	....	....	....	....	3				
Provincetown, Mass.	1873	....	....	....	....	....	....	....	1				
Nantucket, Mass.	1878	....	....	....	....	....	....	....	....	....	?1		
Off Pigeon Cove, Mass.	1881												
Massachusetts Bay	1882	....	....	....	....	....	....	summer 1					
Off Monomoy Pt. Light, Mass.	1883												
Nantucket, Mass.	1887	....	....	....	....	....	1						
Wauwinet Harbor, Mass.	1887	....	....	....	....	....	....	1					
Narragansett Bay, Rhode Island	1887												
Quoddy Head, Maine	1889	....	....	....	....	....	....	....	....	1			
Fort Adams, Rhode Island	1889	....	....	....	....	....	....	....	....	1			
Portland, Maine	1893	....	....	....	....	....	....	1					
Provincetown, Mass.	1895	....	....	....	....	1							
Nantucket, Mass.	1904	....	....	....	....	....	....	....	....	....	....	?1	
Provincetown, Mass.	1905	....	?1										
Provincetown, Mass.	1905	....	....	1									
Provincetown, Mass.	1909	....	....	....	....	....	....	....	1				
South Truro, Mass.	1910	....	....	....	....	1							
South Truro, Mass.	1910	....	....	....	....	....	1						
Provincetown, Mass.	1910	....	....	....	....	....	....	....	1				
Provincetown, Mass.	1911	....	....	....	....	....	1						
Barnstable, Mass.	1913												
	2	0	?1	1	0	3	3	2	7	2	2	?1	0

It is interesting to see from these records, that most of the individuals of which there is any special note, were captured in fish traps close to shore, or in harbors or estuaries. With one exception all those that were actually measured, were under 17 feet in length (the one exception was 22 feet 8 inches). In other words they are chiefly immature animals. That so large a proportion (9 out of 25 records) were taken in fish weirs is indicative not only of the

propensity of this species to frequent bays, harbors, and shallow waters near shore, but also perhaps, implies that they were seeking fish for food — herring probably. That so large a number were youngish might be due merely to their lack of experience and wariness, so that they did not avoid the traps which older and more experienced individuals might have shunned. By far the greater part of the captures are in summer, but this may be partly due to the lessened activity with the fish traps in winter, although the abundance of herring in summer is the more probable explanation.

It is noticeable that the records include the entire Maine coast, are most numerous for the tip end of Cape Cod, whose hook-like barrier seems to act as a leader to bring roving sea creatures to Provincetown, thence extend to the waters about Nantucket and the bays of Rhode Island, but do not take in Connecticut. This is in accord with what has been shown for the other species of large whales, that they are much less frequent in Long Island Sound, and seldom penetrate beyond its eastern end.

Economic Value.

The amount of oil is too small and the whales are too scattered to induce fishermen to undertake their pursuit. The whalebone is of no value on account of its small size. The occasional individuals taken in fish traps in our waters are either dispatched as nuisances by the fishermen or allowed to escape if they will without damaging the nets. On the Labrador coast, however, one is killed now and then to provide food for the hungry Eskimo dogs, and in Greenland waters they are sometimes killed for food by the Eskimos. Egede (1745) who was for twenty-five years a missionary in that country, says in speaking of the Fin Whales that occasionally were obtained, "The Greenlanders make much of them, on account of their Flesh, which, with them, passes for dainty Cheer."

Enemies and Parasites.

So far as known the Little Piked Whale has no special enemies among the larger predacious fish or marine mammals. No doubt it may occasionally be forced to flee from the voracious Orca, but of this I have found no certain evidence, and its habit of keeping inshore among bays and harbors probably minimizes this danger. On account of its small size and thin blubber it is not an object of pursuit among whalemen.

In the specimen dissected by Carte and Macalister, a number of intestinal parasites were discovered, a species of entozoan known as *Echinorhynchus porrigens*. These were found in the wall of the intestine below the duodenum. Their presence was indicated by a number of hard tubercular bodies, like short blunt cones with a small perforation at the apex of each on the inner wall of the intestine. Each perforation led into a tortuous canal within the wall

of the intestine, which contained the long body of the parasite, firmly fastened at its head end by hooks sunk into the fundus of each canal.

Van Beneden (1859) has described a very large trematode or liver-fluke, *Distoma goliath*, from specimens sent him by Eschricht found in the liver, and he himself found the same species in a specimen captured in the Escaut in 1865.

A species of Ascaris (*A. angulivalvis*) is described by Creplin from the intestine, and a thread worm, *Filaria crassicauda*, is found in the urethral canal and in the corpora cavernosa of the male.

Of external parasites, *Penella balaenopterae*, an aberrant crustacean, is sometimes found, particularly about the genital orifices. It was first described from a specimen taken from a whale of this species captured on the coast of Norway (Koren and Danielssen: Fauna Littoralis Norvegiae, 1877, part 3, p. 157, pl. 16, fig. 1–9). In its adult condition, the body is buried in the flesh of the whale and the slender thoracic portion floats free for some eight inches (180 mm.). A stalked barnacle, *Conchoderma virgata* sometimes attaches itself to the Penella.

†Balaenoptera ?sursiplana Cope.

The Fossil Finback of Gay Head.

Plate 15.

Synonymy.

1842–3. *Balaena* Lyell, Proc. Geol. Soc. London, vol. 4, pt. 1, p. 33; Amer. Journ. Sci. and Arts, 1844, ser. 1, vol. 46, p. 320.

1895. *Balaenoptera sursiplana* Cope, Proc. Amer. Phil. Soc., vol. 34, p. 151.

To this extinct species I shall provisionally refer certain bone fragments, chiefly vertebrae, from the Miocene deposits of Gay Head, Martha's Vineyard, Mass., which are so similar to bones of living Balaenoptera as to be practically indistinguishable. This species was described by Cope from the Yorktown Miocene formation of Maryland on the basis of the tympanic or ear bone, which indicates a whalebone whale of the size of the Common Finback of the present day. Unfortunately it is impossible, on account of the dissociated condition of the parts of the skeleton, to refer any vertebrae definitely to the whale that produced the ear bone, and no ear bones have been discovered in the Gay Head formation to strengthen the supposition that the vertebrae there found are those of *B. sursiplana*. Yet the species occurs in fossil condition throughout the Chesapeake Group of Maryland, and is the only one referred to true Balaenoptera, so that its occurrence in these beds of corresponding age is to be expected.

Occurrence of the Fossils.

The Miocene strata exposed at Gay Head are considered to correspond in age to the lowermost or Calvert Formation of the Chesapeake Group. This is evidenced by the similarity of the fossil mollusks in both beds. Further evidence for this I have recently found in the discovery of a well preserved tooth of the extinct toothed whale, *Basilosaurus* [= *Squalodon*] *atlanticus* from Gay Head, and now preserved in the Museum of Comparative Zoölogy. In the Maryland Miocene this genus is as yet known from the Calvert beds only.

At Gay Head the whale bones are found in a pebbly conglomerate underlying a stratum of greensand (in which are numerous fossil crabs of a peculiar type). They are associated with fossil sharks' teeth and casts of mollusks. Probably at least four genera of Cetacea are represented among the various broken vertebrae in this hard conglomerate. The specimens are chiefly centra with the neural spines or the lateral processes broken off, and present very little that is especially characteristic. No doubt they are the remains of whales that were cast

PLATE 15.

Bones of the fossil Finback Whale referred to †*Balaenoptera sursiplana*, from the Miocene deposits of Gay Head, Martha's Vineyard, Mass.

Figs. 1, 2, 3. Anterior views of three caudal vertebrae from near the end of the series, showing the change from circular to squarish outline as the tip is neared. (Collection M. C. Z., nos. 8743, 8742, 3742.) × ½.

Figs. 4, 5. Upper view of same bones shown in Figs. 2 and 3. The characteristic bracket-shaped depressions and the foramina which open into them for the passage of blood vessels, are clearly seen. × ½.

Figs. 6, 7, 8. The same three vertebrae shown in Figs. 1, 2, 3 respectively, but from the lower side. In Figs. 6 and 7 appears the characteristic rounded pit into which open the two foramina seen in Fig. 4 on the upper side.

Fig. 9. Fragment from the upper part of a rib, in the collection of the Museum of Comparative Zoölogy (no. 8744). × about ½.

Fig. 10. Centrum of a large vertebra showing the bases of the transverse processes and neural spine. The epiphyses had not yet fused to the front and back ends of the centrum. (Collection of the Society, no. 9698). × ⅓.

1

2

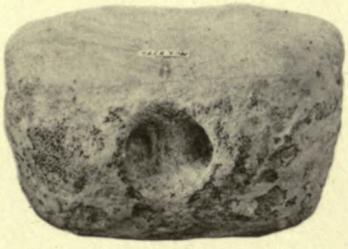
3

4

5

UNIV. OF CALIFORNIA

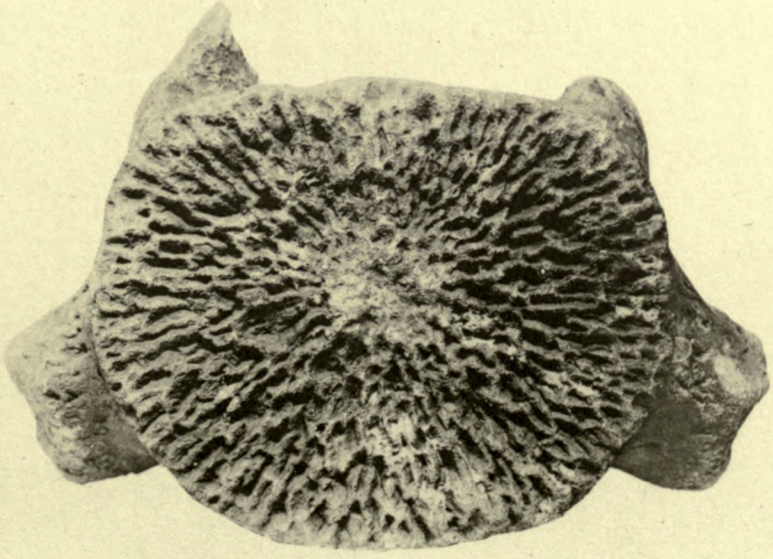
6



7

8

9



10

FOSSIL WHALE OF GAY HEAD.

UNIV OF
CALIFORNIA

up on the ancient shore, and became gradually disintegrated by the tides. No parts of crania have yet been found that might more clearly show the identity of the species. The layer containing the bones is exposed near the top of a seaward bluff, and as the cliff becomes weathered away they are often washed to the shore below. William Baylies,[1] as long ago as 1793, in writing of Gay Head noticed that "the bones of whales, sharks' teeth, and petrified shell fish, are frequently picked up, scattered up and down the cliff, at a considerable distance above the surface of the water." Charles Lyell also mentioned them briefly in 1842–3, and on Richard Owen's authority, identified some of the vertebrae as those of whalebone whales.

The Miocene beds of Gay Head, on Martha's Vineyard, and at Marshfield, Mass., are the most northerly strata of this age yet discovered on the eastern American coast. They lie unconformably upon the pre-Tertiary deposits, and "consist of two members which are strikingly different from each other in their lithologic composition. The lower member, the so-called 'osseous conglomerate' of Hitchcock, is a bed from 12 to 18 inches thick. It is composed of medium sized pebbles of quartz, chert, calcedony and fragments of cetacean bones. The presence of these bones in the formation suggested the name 'osseous conglomerate.' The upper member which lies immediately above the osseous conglomerate, is a bed of greensand which varies in thickness from nothing to 10 feet. At its base it carries rolled fragments of the under-lying stratum, showing that it was deposited unconformably on the osseous conglomerate" (W. B. Clark, Maryland Geol. Surv., Miocene, 1904, p. lxv).

At Marshfield, near Duxbury, Mass., these same beds again appear, with their associated fossils. Dr. C. T. Jackson, in 1850, called attention to this discovery, and at a meeting of the Society on August 7th, of that year, announced that he had received from this deposit "a shark's tooth, a cetacean vertebra, Lignite, and a cast of Tellina." They were obtained from "a clay marl, over a green sand, thirty feet from the surface; they were precisely like those found at Gay Head."[2]

Indian Myth of their Origin.

The Indians of Martha's Vineyard had no doubt been long familiar with these bones that washed from the cliffs, and had a legend to account for them, and other whale bones washed up. Baylies, who visited the locality in 1793, preserves their story as told him by them. He wrote, in part, "In former times, the Indian God, Moiship, resided in this part of the island; and made the crater, described above, [the Devil's Den] his principal seat. To keep up his fires, he pulled up the largest trees by the roots; on which, to satisfy his hunger, he broiled the whale, and the great fish of the sea, throwing out the refuse sufficient to cover several acres. He did not consume all himself; but with a benevolent hand, often supplied them [the

[1] Baylies, William. Description of Gay Head. Mem. Amer. Acad. Arts and Sci., 1793, vol. 2, p. 155.
[2] Jackson, C. T. Proc. Boston Soc. Nat. Hist., 1850, vol. 3, p. 324.

Indians] with food ready cooked. To facilitate the catching these fish, he threw many large stones, at proper distances, into the sea, [these formed the Elizabeth Islands] on which he might walk with greater ease to himself.....When the Christian religion took place in the island, he told them, as light had come among them, and he belonged to the kingdom of darkness, he must take his leave; which, to their great sorrow, he accordingly did; and has never been heard of since."

Age of the Fossils.

How long ago these ancient whales lived in the waters off our coast is in large part a matter of conjecture. Geologists have made a number of calculations, based on the known or estimated rates of deposit and erosion, in an endeavor to arrive at some idea of the age of the Tertiary deposits. The Miocene strata at Gay Head, it is believed, were laid down perhaps two million years ago — certainly a vast lapse of time. Yet the vertebral bones of these whales are hardly to be differentiated from those of living species. But this is perhaps less to be wondered at, since whales breed slowly and have usually but one young at a birth, so that opportunity for the evolution and transmission of differential characters is decreased.

Miocene Conditions.

Of the habits and nature of this extinct Rorqual we can only conjecture. According to Dall (Maryland Geol. Surv., Miocene, 1904, p. cxlii), a comparison of the fossil mollusks from the deposits of this period shows that they comprised for the most part species characteristic of more boreal waters than those of the earliest Tertiary times that preceded. "Some modification of the coast line or sea-bottom, supposedly in the vicinity of the Carolinas or possibly connected with the elevation of the Antilles, diverted the warm currents corresponding to the present Gulf Stream so far off-shore in the early part of the Miocene as to permit of the invasion of the southern coast lines by a current of cold water from the north, bringing with it its appropriate fauna and driving southward or exterminating the pre-existent subtropical marine fauna of these shores. This resulted in the most marked faunal change which is revealed by the fossil faunas of the Atlantic coast of America subsequent to the Cretaceous. A cool-temperate fauna for the time replaced the subtropical one normal to these latitudes, and has left its traces on the margin of the continent from Martha's Vineyard Island in Massachusetts south to Fort Worth inlet in East Florida, and westward to the border of the then existing Mississippi embayment. This seems to have been the limit of effectual invasion by the northern marine fauna."

Probably then, these Balaenopterae lived in the moderately cool waters of the Miocene seas, much as we now see their modern relatives off Newfoundland. How far to the south

they ranged is yet to be discovered, but no doubt they were commonest in the near-shore waters as far at least as the present Carolina coast. Associated with the whale bones, have been found remains of a walrus similar to the existing species, a fact that further indicates somewhat boreal conditions.

Economic Value of the Bone-bearing Strata.

The possible commercial value of the bone-containing beds at Gay Head is commented on by Shaler (7th Ann. Rept. U. S. Geol. Surv., 1888, p. 357). The fragments of bone, are so intermixed with quartz pebbles, that it seems doubtful if the beds can be advantageously worked for the production of phosphates. He adds: "One of the most promising portions of this section lies at the northern end of that part of Gay Head escarpment which faces about west. It is about one hundred feet in thickness and consists of dark greenish-gray sands and clay, which in part are somewhat oölitic in structure. These beds contain a considerable quantity of cetacean bones. They also contain a certain amount of phosphatic nodules which vary in size from a tenth of an inch in diameter up to five or six inches.....Both the nodules and the fragments of bone, as remarked by Dr. Hitchcock, have probably been derived from pre-existing strata, the débris of which makes up this part of the section." Professor Shaler gives the following chemical analysis of the fossil cetacean bones:

Phosphoric acid (P_2O_5)	27.80
Carbonic acid (CO_2)	3.28
Lime (CaO)	27.21
Potash (K_2O)	0.97
Soda (Na_2O)	0.56

Descriptions.

Cope's original description of *Balaenoptera sursiplana* has to do with the tympanic bone of the ear only, which, he wrote, differs from that of other species of the genus in the "convexity of the superior face where the dense layer or lip has a different chord or face from that of the space which separates it from the internal longitudinal marginal angle. In the *B. sursiplana* there is but one superior plane from the eustachian orifice to the internal edge, which is absolutely flat. In all these species also the dense layer of the lip is reflected on the superior edge of the external thin wall at its anterior end. In the present species this layer is reflected in a very narrow strip underneath the free border, which overhangs it. In all these species also the anterior extremity, as viewed from above or below, is angulate, the angle marking the end of the inner border of the dense layer or lip. In *B. sursiplana* the anterior extremity, viewed in the same way, is truncate. The species which appears to approach nearest is the *B. definita* Owen.....In size this species is like that of the large Balaenopterae." The measurements

of the tympanic bone are given as follows by Cope: axial length, 98 mm.; width at posterior extremity of anterior hook at superior border, 71; width at anterior extremity of orifice, 35; width at posterior extremity of orifice, 53; depth at middle (circa), 55; greatest depth of lip, 38.

A well preserved centrum (Plate 15, fig. 10) from Gay Head, in the Society's collection (no. 9698) is here referred provisionally to this species. It is probably a lumbar or a posterior dorsal, and evidently belonged to an immature animal since the vertebral epiphyses had not fused to the centrum and are lost. The face of the centrum is broadly elliptical; the neural spine has been broken off except for a fragment of the base on each side between which the superior part of the vertebra is flattened. The lateral processes are broken short off about 40 mm. from the body of the bone. They are broadly elliptical in section and rather stout in proportion compared with the Common Finback, directed slightly downward. On the ventral side of the centrum is a slight median keel, with a shallow depression on each side of it, in the middle of which is a large perforation. The greatest length of this centrum is 145 mm.; vertical diameter of centrum, 135 mm.; transverse diameter of centrum, 168 mm.

In the collection of the Museum of Comparative Zoölogy are a number of centra from Gay Head of various sizes and belonging evidently to at least three if not four different genera of Cetacea. Among these are three caudal vertebrae, nearly complete, which are so like those of the modern Balaenoptera as to be generically identical. The largest of these (M. C. Z. 8743; see Plate 15, figs. 1, 6) is nearly circular in outline and is evidently from the posterior part of the peduncle. The epiphyses are fused to the body which indicates an adult animal. Two foramina open into an elliptical pit in the center of the lower side, but the condition on the upper side is obliterated. This bone measures: —

Vertical diameter	110	mm.
Transverse diameter	117	"
Greatest fore-and-aft thickness	78	"
Diameters of the ventral pit about	24×17	"

The second vertebra (M. C. Z. 8742; Plate 15, figs. 2, 4, 7) is from a still more posterior position and though essentially round, begins to show a rectangular outline, due to flattening from above and below. The two foramina that penetrate it vertically open one at each end of a long transverse groove which is bracket-shaped, and on the lower side come together in a shallow pit as in the first specimen. The bone measures: —

Vertical diameter	91	mm.
Transverse diameter	96	"
Greatest fore-and-aft thickness	67	"
Diameters of the ventral pit about	25×26	"
Transverse width of the dorsal groove	64.5	"

The third vertebra (M. C. Z. 3742; Plate 15, figs. 3, 5, 8) must have come from near the end of the series, and is much more flattened, so that the outline is rectangular with rounded cor-

ners. The posterior epiphysis is lost. There is no ventral pit to be seen, but the upper groove is similar to that in the vertebra just described. The bone measures: —

Vertical diameter	76	mm.
Transverse diameter	88	"
Greatest fore-and-aft thickness	48	"
Transverse width of dorsal groove	68	"

The Museum of Comparative Zoölogy contains also a fragment of a cetacean rib which I would refer with little hesitation to the genus Balaenoptera, and to the same species represented by the terminal bones of the spinal column. This fragment (no. 8744; Plate 15, fig. 9) is from near the upper part of the rib, where it curves to articulate with the transverse process of the vertebra. It is about 210 mm. long, and 80 mm. in diameter across its broader end. It is much flattened and has on one surface a broad shallow groove running along its length as in the living Balaenoptera. In the modern Right and Sperm Whales, the ribs are much more rounded and stouter, without this groove. In section, the fragment is triangular at the proximal end where the head of the rib begins to take shape; at the other end it is more nearly oval in section, 35 mm. in diameter transversely. Judging from the shape of the fragment, it must have come from one of the ribs near the hinder end of the series.

Acknowledgments are due to the Museum of Comparative Zoölogy for the privilege of studying and recording these as well as other specimens of New England Cetacea in its collection.

Megaptera nodosa (Bonnaterre).

Atlantic Humpback Whale.

Plate 11, Fig. 5; Plate 16.

Synonymy.

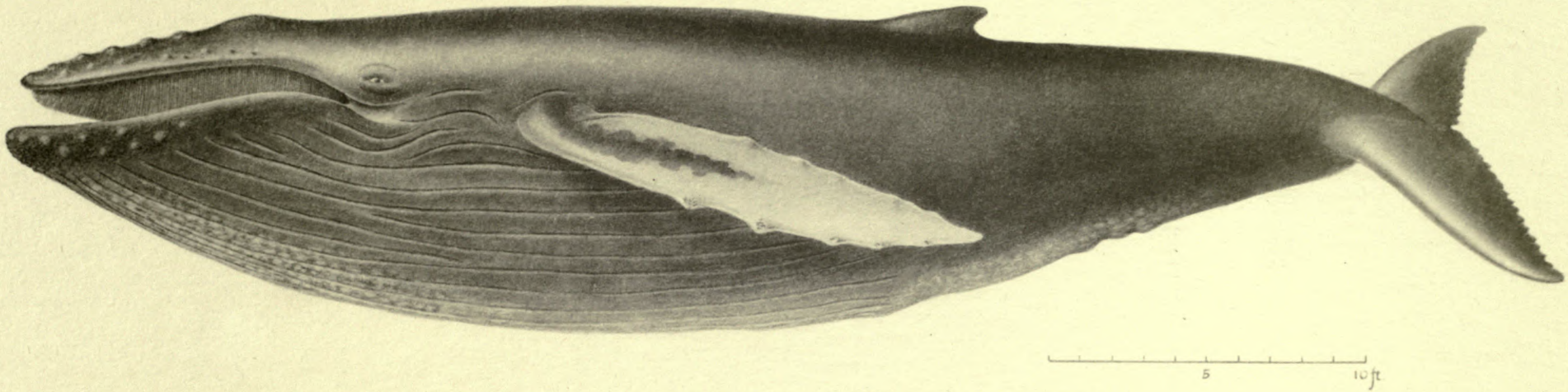
1777. *Balaena gibbosa* Erxleben, Syst. Animalium, p. 610 (in part).
1780. *Balaena boops* Fabricius, Fauna Groenlandica, p. 36; (also many later authors, but not of Linné, 1758, which is *Balaenoptera physalus*, young).
1789. *Balaena nodosa* Bonnaterre, Tabl. Encyclopéd. et Méthod. des trois Règnes de la Nature, Cétologie, p. 5; True, Proc. U. S. Nat. Mus., 1898, vol. 21, p. 635.
1832. *Balaena longimana* Rudolphi, Abhandl. K. Akad. Wiss. Berlin, p. 133–144, pl. 1–5.
1834. *Physeter gibbosa* Dewhurst, Nat. Hist. Cetacea, p. 168.
1837. *Balaenoptera longimana* Rapp, Die Cetaceen zoologisch-anat. dargestellt, p. 55.
1845. *Balaenoptera* (*Boops*) *boops* Brandt, in Tchihatcheff's Voyage Sci. dans l'Altai Oriental, p. 438.
1846. *Megaptera longimana* Gray, Zool. Voyage Erebus and Terror, Mammalia, p. 17.
1846. *Megapteron longimana* Gray, Zool. Voyage Erebus and Terror, Mammalia, p. 51.
1846. *Megaptera americana* Gray, Zool. Voyage Erebus and Terror, Mammalia, p. 17.
1846. *Megapteron americana* Gray, Zool. Voyage Erebus and Terror, Mammalia, p. 52.
1861. *Kyphobalaena longimana* van Beneden, Mém. Acad. Roy. Belg., Bruxelles, vol. 32, art. 3, p. 38.
1862. *Megaptera boops* Lilljeborg, Upsala Universitets Årsskr., 1861–62, p. 88 (of separate).
1865. †*Eschrichtius robustus* Gray, Ann. Mag. Nat. Hist., ser. 3, vol. 15, p. 493; Proc. Zool. Soc. London, 1865, p. 40 (not of Lilljeborg).
1865. *Megapteron boops* Gray, Synopsis Whales and Dolphins British Museum, pl. 30 (jaws of a foetus).
1865. *M*[*egaptera*] *gigas* Cope, Proc. Acad. Nat. Sci. Phila., p. 179 (*errorim*).
1865. *Megaptera osphyia* Cope, Proc. Acad. Nat. Sci. Phila., p. 180.
1866. *Megaptera longimana* var. 2. *moorei* Gray, Cat. Seals and Whales British Museum, ed. 2, p. 122.
1868. *Kyphobalaena keporkak* van Beneden, Bull. Acad. Roy. Belg., Bruxelles, ser. 2, vol. 25, p. 12, footnote; p. 109.
1868. *Kyphobalaena asphyia* (sic) van Beneden, Bull. Acad. Roy. Belg., Bruxelles, ser. 2, vol. 25, p. 117.
1868. *Kyphobalaena americana* van Beneden, Bull. Acad. Roy. Belg., Bruxelles, ser. 2, vol. 25, p.122.
1871. *Megaptera bellicosa* Cope, Proc. Acad. Nat. Sci. Phila., vol. 12, p. 107.
1898. *Megaptera novae-angliae* Trouessart, Cat. Mamm., fase. 5, p. 1085 (quoting Brisson and Gmelin where, however, the name is not used in a nomenclatorial sense.)

History and Nomenclature.

The Humpback Whale of the North Atlantic was well known to whalers for considerably more than a century before it was studied and named by zoologists. In the middle or latter part of the 17th century it was regularly hunted at the Bermudas, and later, in New England waters. Paul Dudley, in his famous essay of 1725, gave a brief description of it, as one of the five species of whales occurring on the New England coast. The earlier systematists included

PLATE 16.

Humpback Whale (*Megaptera nodosa*). Drawn by J. Henry Blake from measurements.



HUMPBACK WHALE.

SMITHSONIAN LIBRARIES

HELIOTYPE CO., BOSTON

UNIV. OF
CALIFORNIA

this New England whale in their lists of animals and it therefore forms the basis of their Latin names. Thus Erxleben in 1777, and following him, Gmelin (1788) and Kerr (1792) confuse it with the Scrag Whale of Dudley, and include both under the name *Balaena gibbosa*. But the Scrag Whale was doubtless *Eubalaena glacialis*, and the name if considered recognizable, is a composite referring in part to both species. Although Fabricius, a Greenland missionary and author of the Fauna Groenlandica (1780), was well acquainted with the species as it occurred in the seas of southern Greenland, he considered it the same as Linné's *Balaena boops*, and so refers to it in his work. As shown by True (1898, p. 624), however, this name was based on the young of the Common Finback. Nevertheless, this fact was not then appreciated, and the specific name *boops* has been much used for the Humpback by later writers. Under this name in 1818, Fabricius gives a very full account of the species as known to him. He also introduced the name Keporkak by which the Greenland natives knew it, and this was subsequently used as a specific term for the species. Meanwhile, however, the Abbé Bonnaterre in his treatise on Cetacea, published in 1789, definitely adopted the name *Balaena nodosa*, basing his account on Dudley's Humpback, and giving as the known range "Nouvelle Angleterre." He cites other authors, who, as True points out, are likewise wholly indebted to the same source. The name is therefore the first post-Linnean designation that can be unequivocally applied to a Humpback Whale, and since True has shown that there is no ground for distinguishing the whales of the two sides of the North Atlantic, it will stand as the technical name of the North Atlantic Humpback. In 1832 the German naturalist Rudolphi described a specimen stranded at the mouth of the Elbe, and proposed for it the name *Balaena longimana* in reference to the very long pectorals. This and Fabricius's contribution were the first accurate memoirs on the species, so that it is barely a century since it may be said to have been known to science.

Although Brandt in 1845 made a subgenus Boöps for this whale (preoccupied by Boöps Cuvier for a genus of fishes), and placed it in Lacépède's genus Balaenoptera, it was not until 1846 that the English naturalist J. E. Gray distinguished the Humpbacks as forming a distinct genus from the other whalebone whales, by reason of the peculiarities of the skull and shoulder blade, lack of a falcate dorsal fin, and particularly by the extraordinarily long pectorals. Hence the generic title Megaptera (μέγα, large, and πτέρον, a wing or flipper); the specific name *nodosa* refers of course to the irregular knobs on the head and limbs. Eschricht, in 1849, proposed Kyphobalaena as a group name for the Humpbacks, but this is antedated by Gray's generic name. Van Beneden, nevertheless, used Kyphobalaena in a generic sense for the Humpbacks in several of his papers on Cetacea, and is thus responsible for sundry combinations in which this name occurs. For Eschricht, although often quoted as author of the genus, nowhere uses it so. Rudolphi's specific term *longimana* has long been current for the species; but Gray in 1846 gave the name *americana* to a supposed distinct Humpback from Bermuda.

Cope, in 1865, described the skeleton of a specimen found dead off Petit Manan Lighthouse, Maine, and believing it to be distinct, gave it the specific name *osphyia*. This skeleton is still preserved in the Niagara Museum. On similar grounds he named a West Indian specimen *M. bellicosa* but True (1904) has shown that all these names must be considered synonyms of *nodosa*. Gray's "var. *moorei*" founded on a young skeleton in the Liverpool Museum must be added to these, as the characters claimed for it seem to be mere individual peculiarities. Other names, generic and specific, have been given the Humpbacks of the Pacific and the Southern Ocean, but the true status of these supposed forms is still uncertain and the names are not here considered.

A fossil Humpback apparently identical with the living species has been reported from the Pleistocene deposits of eastern Canada. J. E. Gray also described in 1865 a single neck vertebra found in subfossil condition on the coast of Devonshire, England. He considered it to represent Lilljeborg's †*Eschrichtius robustus* — a subfossil Finback Whale from Sweden — but it was probably from a Humpback.

The type locality of the North Atlantic Humpback is given by Bonnaterre as "Nouvelle Angleterre" basing his original description on Dudley's account of the New England Humpback.

Vernacular Names.

Among the whalemen this is universally known as the Humpback to distinguish it from the "Whale" (which commonly meant the Right Whale on our coasts) and the Finbacks; hence the verb "humpbacking" as applied to the local cruises in pursuit of the species from our ports. Other vernacular names are mere variants — thus Dudley speaks of it as the "Bunch, or Hump-back Whale," Turton writes it "Hump Whale," and Gray and Cope have rendered it "Hunchbacked Whale." In other tongues it is called Buckelwal or Pflockfisch in German, Stubhval in Danish, Baleine à bosse in French, Knölhval by the Norwegians. All these names refer either to the large dermal tubercles (Knölen) or to the small adipose fin on the lower part of the back, which is spoken of by Dudley as "a Bunch standing in the Place where the Fin does in the Finback. This Bunch is as big as a Man's Head, and a Foot High, shaped like a Plug pointing backwards." Bonnaterre's term "Tampon" Whale like the German Pflockfish is merely a translation into French of this word "Plug." Eschricht suggests that the name Humpback is derived from the rounded appearance of the animal as it dives. The native name Keporkak of the Greenlanders was first introduced into scientific literature by O. Fabricius in 1780, and is found in works of later writers.

Description.

Form.— The body is rather short and robust in comparison with the Fin Whales, and the peduncle too seems shorter in proportion. The throat folds, extending from the lower margin of the jaws back to the region of the navel, are fewer and much farther apart than in the genus Balaenoptera. In three Newfoundland specimens, True found the number of these folds to be 14, 20, and 22 respectively between the pectoral fins, and the widest were from 5 to 8 inches. A fold or two is present at the corner of the mouth, passing to the pectoral, back of which may be two or three short transverse furrows. As in the Fin Whales, the folds on the throat anastomose in some degree. Thus a fold from the lip may unite with a second or it may itself bifurcate, forming two; others run continuously from the lower margin of the ramus to the abdomen. The most median folds do not end at the point of the jaw but a slight distance back from it, forming there a slight eminence or "chin" (as Struthers puts it).

A characteristic of the Humpback is a series of dermal tubercles on the rostrum and jaws (True's plate, 1904, Plate 41, shows them well). There is much variation in the number of these, but on the snout they are arranged in three rows: a median row of usually about five to seven extending from the blowholes to the snout, and a lateral row of from eight to thirteen on each margin of the upper jaw, commencing slightly in advance of the angle of the mouth. On the lower jaw is a distinct group of tubercles on each side of the symphysis, and an irregular series of a dozen or more along the side of each mandible, often in a more or less double series.

The blowholes are situated on a slight eminence at the vertex of the head. In shape they are a little convex toward each other and converge anteriorly. There is a median linear depression about an inch deep between them.

In a specimen hauled ashore and resting on its belly, there is seen to be a distinct depression at the neck.

The pectoral fin is of extraordinary length and flexibility. It is longer than that of any other whale, from 30 to 36% of the total length. The anterior outline is gently convex, with a recurved tip; the posterior margin is similar, becoming concave at the tip. The anterior margin has a series of eight prominent knobs, corresponding to the carpal joint and the joints of the phalanges of the short first and long second bony fingers. The knobs corresponding to the base and the tip of the first finger of the skeleton are largest. Between them are two smaller knobs, and distal to the second big knob, are the four remaining. There are a few smaller protuberances at the tip on the posterior margin as well.

The dorsal fin of the Humpback, though subject to considerable variation in shape and size, is in reality not very different in form from that of the Finbacks, though commonly rather less falcate, more ridge-like, and truncate posteriorly, not like a hump as might be thought.

An excellent photograph of two living Pacific Humpbacks in which the extremes of form in the dorsal fin are shown, is published by Andrews (1909, Plate 34, fig. 2).

The flukes are rather broad, and set at an angle of nearly 45 degrees to the axis of the body. Posteriorly there is a deep median V-shaped notch as in the Fin Whales. The hinder margin is remarkable for its toothed or serrate appearance, due to irregular projections, of which the longest are along the terminal half. These suggest by their appearance some injury to the edge of the flukes, but are in reality wholly normal, since they are present in a large-sized foetus.

The outline of the caudal peduncle is broken by a rounded protuberance just behind the anus, terminating in a deep transverse groove, and succeeded by a second compressed elevation. Anterior to the anus in both sexes is a rounded elevation, which in the male, contains the penis (True).

Struthers describes well developed nipples in a male specimen, situated one on each side, a foot and a half behind the preputial opening and two feet in front of the anus. Each is enclosed within a shallow pouch whose opening is protected by a soft fleshy projection.

The ear opening is a small hole, rather ovoid in shape, and about large enough to admit "a rather small-sized uncut goose-quill" (Struthers). In the specimen described by Struthers it was situated "17 inches behind the posterior canthus of the eye-lids, and 2 to 3 inches below the level of the eye."

Vestiges of Teeth.— In a foetus 35 inches long, Eschricht (1849, Plate 4) has described and figured the vestigial teeth, which are arranged as in the toothed whales, in a long series in each jaw. They are small and bluntly conical, 28 on a side in the upper jaw, 42 on each side in the lower (in a 45-inch specimen) and in some cases were double-rooted. These are all that remain of a once functional set of simple teeth, and indicate the derivation of this and other whalebone whales from toothed whales. These embryonal teeth are resorbed and disappear before birth.

Weight.— There are very few data as to the weight of these great mammals. Goodall (1913) writing of the Humpback Whale of the Indian Ocean, says that the whalemen reckon its weight as approximately a ton for each foot of length, so that a 45-foot whale would weigh about 45 tons. The basis of this computation is not related, but it may be a too liberal allowance. Guldberg (1907) has tried to compute the weight by considering the body of the whale as similar to a solid composed of two cones base to base, of which the combined length and greatest diameter are to be measured and the volume, and thus the weight, obtained by a mathematical formula. The specific gravity of the whale is considered the same as that of water. This computation gives a weight of about 18 tons for a 40-foot Humpback (=18,283 kilograms), which is of course approximate only. A newly-born calf, taken in the Indian Ocean, is said by Goodall (1913) to have measured 16 feet in length and to have weighed two tons.

Color.— A young female taken at Provincetown, Mass., in 1879, is described by True as having the upper surface of the head, body, and flukes black; "the upper surface of the pectoral,

white, with a black mark extending along the axis from the root about half way to the tip, but not wide enough to reach the margins of the fin"; the lower surface of the pectorals was similarly colored and the posterior margin was irregularly marked with black. Each lobe of the flukes below had a large central white area, surrounded by a broad black border. The lower side of the body is usually black, more or less marbled with white on the throat and breast. Furrows on the belly light purplish flesh color.

Variations from this pattern are due to the greater or less amount of white, and this generally on the lower surfaces. The dorsal fin may be irregularly spotted or blotched with white or its front or hind margins may be white. The throat and breast may be almost wholly black to almost all white, varying in every individual, but the belly is usually black, sometimes with white spots, and the margins of the jaws are commonly black. The pectorals are always white below, apparently, but above there is usually a basal black area which may be confined to a narrow central tongue or may reach to the anterior margin or even quite across the base, and encroach a trifle on the lower side in front. Again the black may extend as a narrow edging along the hinder margin of the pectorals.

Rawitz (1900) advances some evidence for supposing that the white breast is more often present in adult animals, and that the immature specimens are more often black below; Captain David Gray, an experienced whaler, also informed Struthers (1889, p. 16, foot note) that in the Bowhead the amount of white below increases with age.

Hair.— Rawitz (1900, p. 73) found one or two short bristles on each of the dermal tubercles of the lower lip, and at the symphysis a single bristle at the summit of the numerous and irregular tubercles at this point. A single whitish bristle projects from each of the double row of tubercles on either side of the upper jaw. Other hairs are found between these knobs, growing from wrinkles of the skin. Rarely these bristles are yellowish. The tubercles probably correspond to the slight swellings from which the hairs project in the Fin Whales, but in the latter, the number is less and the arrangement seems slightly more definite. Where two hairs grow from a single knob, it seems to be a case of fusion of two tubercles, morphologically distinct.

Baleen.— The general appearance of the whalebone is dark brown, with coarse bristles of a similar color. True describes it as grayish black, the bristles along the exterior the same, but those towards the middle of the mouth paler. These bristles are about four to six inches long and form a matted mass. Often the anteriormost plates are white in part, but this appearance may be confined to those of one side only. The baleen plates number about four hundred on each side, and the longest of these scarcely exceed two feet. True found the longest to be 22 inches in a Newfoundland whale of 45 feet.

External Measurements.— In comparison with the larger Fin Whales, the Humpback is much shorter. Adults of both sexes probably seldom exceed fifty feet over all. True found 47 feet the longest of those he measured at Newfoundland, and although some of the Norwegian specimens are said to have been larger, he points out that these measurements may be "over

all" instead of from tip of upper jaw to notch of flukes. An 88-foot specimen recorded in the Philosophical Transactions of the Royal Society as taken at Bermuda in 1665 must have been a very extraordinary animal if the account can be accepted, but the evidence of later investigations is rather against it. I am unable to add to the recorded measurements of the species. True (1904, p. 222) gives the following measurements of a Newfoundland female.

External Measurements of a Humpback Whale.

	Ft.	In.	Meters
Length, tip of snout to notch of flukes	45	5	13.84
Tip of snout to eye (center)	11	2	3.40
" " " " posterior insertion of dorsal fin	30	2	9.19
" " " " blowhole	8	4	2.54
" " " " anterior insertion of pectorals	16	0	4.87
" " " " axilla	17	0	5.18
Vertical height of dorsal fin	1	0	0.30
Length of pectoral from head of humerus	15	2	4.62
" " " " posterior insertion	12	9	3.88
Breadth across flukes	17	4	5.28
From notch of flukes to anus (center)	10	11	3.32
" " " " " clitoris	12	9	3.88
" " " " " navel	19	0	5.79
Depth of caudal pedunele at insertion of flukes	3	4	1.01

True also gives the proportions in percentages of total length of a female specimen taken at Cape Cod, Mass., and now in the U. S. National Museum. These proportions are of a younger female and are of interest in comparison with the adult and larger animal from Newfoundland, the measurements of which I have copied above. Following are these percentages for the two specimens as given by True.

	Newfoundland ♀	Cape Cod ♀
Total length in feet and inches	45′ 5″	32′ 5.5″
Percent of total length, tip of upper jaw to eye	24.6	21.5
" " " " " " " " " blowhole	18.4	18.7
" " " " " " " " " pectoral	35.2	28.4
" " " " " " " " " back of dorsal fin	66.4	70.6
" " " " " " " " " corner of mouth	——	22.0
" " " " length of pectoral from axilla	28.1	28.4
" " " " greatest breadth of pectoral	——	6.1
" " " " height of dorsal	2.2	2.5
" " " " breadth of flukes, tip to tip	38.2	27.1

These percentages show a general agreement, but indicate a relatively smaller head in proportion to total length in the smaller animal. The only other striking difference is in the relative breadth of the flukes, which is much less in the latter.

Musculature.

Forearm and Finger Muscles.— Notwithstanding the great size of the pectoral limbs in the Humpback, the muscles of the forearm and fingers are actually "not half the size" of the same muscles in the Finback, as Struthers has shown. He found four of these muscles developed, the same four that are present in the Finback. He describes the *flexor carpi ulnaris* as thick and fusiform, not spreading fan-like as in the Finback although it is not of less size. Its origin is entirely on the cartilaginous olecranon, or elbow, and it is fleshy for about half its length or 11 inches, after which it passes into a tendon of elliptical cross-section, and inserts into the proximal border of the pisiform cartilage.

The *flexor digitorum ulnaris* resembles the same muscle in the Finback but is much smaller. It is a flattened narrow muscle, about 1.5 inches in greatest width at the middle. Its origin is from the ulna and its long tendon joins that of the *flexor digitorum radialis*. The latter is the larger, and arises from the ulna as well as from the radius. At about the junction of the middle and distal thirds of the forearm its tendon joins that of the *flexor d. ulnaris*, and a tendinous expansion is here formed, from which a separate tendon runs to the end of each digit.

On the upper side of the flipper is but a single well developed muscle, the *extensor digitorum communis*. Like the others, this is fleshy for but a short distance from its origin at the proximal portion of both radius and ulna. It soon narrows to a large tendon which forms a triangular expansion on the distal half of the carpus. From this pass off the four tendons, one to each digit. That to digit II is the largest, that to digit V the smallest. These tendons are attached to all the joints of the phalanges, and serve apparently through their tension to give additional stiffness to the great paddles.

Pelvic Muscles.— Struthers has given an account of the muscles attached to the vestigial pelvic bones and femora. The relations are in general similar to those in the Finback. "Passing across between the posterior ends of the pelvic bones is the *great interpelvic ligament*....It ties the pelvic bones together posteriorly, and supports the crura penis, which are involved in its tissue anteriorly, and entirely rest on it. Behind, it attaches the anterior part of the *levator ani muscle*, and more externally the inner part of the caudal muscular mass. Along the posterior edge of the great ligament is seen the posterior edge of the *transversus perinei muscle* mostly concealed by and attached to the ligament; as broad and as thick as the palm of the hand and 6 to 8 inches in length transversely. In the ring between this muscle and the beginning of the levator ani muscle, is seen the *retractor penis muscle*, rope-like, right and

left, passing forwards on the under surface of the penis." The vestigial femur has a small muscle, the *retractor femoris*, ensheathed in ligament, and originating from the great interpelvic ligament. It runs to the head of the femur, serving to pull it backward and a little inward. Struthers states that he could not find the corresponding muscle in the Finback; he further points out that its action is opposed by ligamentous connections. There would seem to be little obvious cause for the retention of the femur and its connections.

Skeleton.

(For a detailed account of the skeleton see Struthers, 1889.)

The skull differs in many details from that of the Finbacks. Compared with that of the Common Finback Whale the more striking points may be briefly stated as follows. It has a proportionately shorter and broader rostrum, whose outline passes basally by a sweeping curve into that of the sides. The intermaxillaries expand slightly towards the tips, instead of tapering evenly. The general profile of the skull is somewhat more curved than in the latter. The shape of the nasals is rather characteristic: the two are produced upward to a sharp median point, but their free edges are scarcely notched. There is also a slight median projection of the frontals that separates the two nasals. The temporal opening is broader, and the frontals are much narrowed laterally instead of being nearly square, owing to the backward trend of the anterior border of the orbital plate. They thus approach the condition seen in the Right Whale, where these bones are greatly narrowed. The huge supraoccipital, forming most of the roof and back of the brain case, is narrower instead of broader than the condyles, at its vertex, and has a very faint median ridge, or none, instead of a well developed crest. Its sides converge regularly to the summit where it is broadly truncate; but in the Finback they become nearly parallel for the dorsal third. In ventral aspect the palatals are relatively shorter and more rounded at the ends. The coronoid process of the lower jaw is also less developed.

In the following table (p. 297) are given the cranial measurements of a Humpback skull (probably from Cape Cod) in the Museum of Comparative Zoölogy.

The vertebral formula may be taken as C 7, D 14, L (10) or 11, Ca 21 = (52) 53, according to True, who includes three New England specimens in his reckoning. All agree as to the number of cervical and of rib-bearing vertebrae, but two have ten and one has eleven lumbars, while the caudals vary from 19 to probably more. The loss of the minute terminal bones of the spine often causes some uncertainty as to the exact number of caudals, but Rudolphi records 22, other writers 21 in specimens examined. The latter probably represents the normal number.

The cervical vertebrae are all free normally, and differ remarkably from those of the Fin Whales in the reduction of the processes that form the vertebrarterial canal. In the second

Measurements of a Humpback Skull (M.C.Z. 6177).

	mm.	Ft.	In.	Percent of total length of skull
Greatest length in a straight line	2000	6	6.7	100
Length of maxillary on upper side of skull (straight)	1520	4	11.8	76.0
" " intermaxillary " " " " " "	1530	5	0.2	76.5
Greatest width across squamosals	1318	4	3.8	65.9
" " of supraoccipital	735	2	4.9	36.7
" " across base of rostrum (in front of zygomatic processes of maxillaries)	710	2	3.9	35.5
" " across zygomatic processes of maxillaries	1215	3	11.8	60.7
Least width at vertex	190	0	7.5	9.5
Outer edge of orbital process of frontal	210	0	8.3	10.5
Inner border " " " " "	495	1	7.5	24.2
Nasals, median length	170	0	6.7	8.5
" combined width in front	165±	0	6.5	8.±
Breadth across condyles	260	0	10.2	13.0
Greatest length of palatal bones	445	1	5.5	22.2
" " " tympanic	115	0	4.5	5.7
" " " lower jaw (straight line)	2140	7	0.2	107.0

cervical this canal, at its inception, is open on account of the failure of the dorsal and ventral processes to unite laterally. In the third, fourth, and fifth vertebrae the ventral processes are successively reduced, and on the sixth and seventh are lacking entirely. In the Finbacks the canal is usually closed throughout the seven cervicals, though occasionally in the last one or two the ring is incomplete.

In an immature specimen from Provincetown, True found the last neural spine to be on the 40th vertebra and the last transverse process on the 38th. (For detailed measurements and proportions of the vertebrae see Struthers, 1889, p. 61, and True, 1904, p. 234.)

The dorsal spines of the vertebrae are rather narrower in lateral aspect than in the Finback, with less tendency to expansion at their tips. The transverse processes similarly are much less expanded terminally and are less flattened.

The chevron bones are said to be only nine in a young specimen from Cape Cod (U. S. Nat. Mus. 16252), but there may possibly be two or three more.

The ribs are in general shorter and stouter than in the Finback, except the two first, which are actually longer. The longest rib in both is the sixth. Struthers found, further, that the degree of curvature is greater in the Humpback, thereby giving it a wider thoracic cavity.

The sternum is of characteristic form, thick and broad, with two lateral rounded wings, and a short posterior portion. Its shape is subject to much individval variation, however.

The first pair of ribs articulates with it, one on each side, *behind* the lateral wings. The articulation is by a cartilaginous band, continuous along the inner edge of the termination of the rib, differing from that of the Finback in which the attachment is by an anterior and a posterior ligament.

The scapula is remarkable for the complete loss of its acromion, though near the anterior border, externally, is a slight ridge that indicates the location of the spinous process. The coracoid is faintly developed also, as a rounded knob at the anterior border of the glenoid cavity. The outline of the scapula (text-fig. 7, p. 191) is further characteristic in being somewhat fan-like, with a high and evenly convex vertebral border. The posterior outline is slightly and rather evenly concave, but the anterior border varies from slightly concave to nearly straight above the basal portion, or towards the antero-dorsal angle. True (1904) shows very conclusively that the relative breadth of the scapula increases regularly in proportion to the length of the skull.

The humerus is short and massive, and the radius and ulna are likewise heavily fashioned. The radius is much larger than the ulna, broadly expanded at the distal extremity, and nearly straight. The ulna is much curved and is remarkable for the great reduction of the elbow or olecranon, which in the Fin Whales is produced proximally so as to overlap the outer edge of the humerus.

The carpus consists of five more or less cartilaginous elements in addition to the large pisiform, which stands out as a broad expansion on the ulnar side. These elements are marked off by surface grooves, and seem not to ossify till late in life. In the proximal row are represented (1) the large ulnare which articulates with the outer portion of the radius, (2) a small intermedium, and (3) a radiale, both of which articulate with the radius only. Of the carpalia but two are present, which correspond apparently to digits II and IV.

The digits are four in number, and it is generally considered that it is digit I that is wanting but Kükenthal's researches indicate that it is probably the third. Hyperphalangy is shown in digits II and IV, which together form the terminal half of the hand. The number of phalanges in the four digits is, respectively, 2, 7, 6, 3, according to Struthers, but True gives for two Cape Cod specimens, as mounted, 2, 6, 6, 2 and 2, 7, 6, 1 respectively.

The pelvis is represented by a single three-cornered bone on each side of the body, both of which are joined together by a thin sheet of connective tissue. The anterior end, which is taken to represent the ilium is tapering and rounded. The posterior end, corresponding to an ischium is stouter. Including the cartilages at each end, the pelvic bone is about 9.25 inches long. There appears to be no trace remaining of an acetabular cavity such as is present in the Right Whale and the Finback.

The femur is a very small nodule, entirely cartilaginous in small specimens, but becoming ossified in adult animals. It measured 5 inches in length on the right side, 3.75 inches on the

left side in the specimen described by Struthers, and tapered greatly at the free end. It is loosely connected to the pelvic bone through short fibrous bands, at a point internal to the outer angle of that bone.

Appearance and Actions.

As viewed at sea, the Humpback has several characteristics that may serve for its identification. As with the Rorquals, it rises to the surface, delivers its 'spout' as the vertex of the head breaks the water, then as the blowholes remain widely open for the quick inhalation, a large portion of the forward part of the back appears momentarily. With the closing of the blowholes, the head is depressed, and much of the back appears, sometimes quite to the dorsal fin. The posterior part of the back arches slightly as the head goes down, the dorsal fin moves forward with the onward course of the body, and as it approaches the water again, the whale sinks beneath the surface leaving a 'slick' or round area of smooth water, behind. This is the intermediate or surface dive of which several may be made in succession as the whale feeds among the plankton currents or refreshes its lungs after a longer dive. Millais noted in one individual eight, ten, and twelve of these shorter dives successively between the deeper soundings. The longer dive differs in that the whale goes down in a nearly perpendicular course, more of the posterior part of the body appears above the surface with the greater effort, and the flukes of the tail finally rise clear of the water, and following the forward rolling of the body, dip in nearly vertically, looking like the spread wings of a great bird as they disappear. In these deeper dives the animal may be under water for a number of minutes, but in the shallow dives, for a few seconds only. Rawitz (1900) relates that one which was slightly wounded by a harpoon stayed down for twenty minutes, and in a free state the long dives were of about fifteen minutes duration. A pair of Humpbacks that I saw July 1, 1911, in the Atlantic, 45° 15′ N., 37° 44′ W., impressed me as being most leisurely in their surface movements. They were in sight from the steamer for several moments, swimming at the surface, so as to expose the entire back from the posterior part of the head to just behind the dorsal fin, which appeared large and obtusely triangular. At intervals of about 15 seconds, the head was raised slightly to expose the blowholes for breathing, then after the spout, the head was lowered and the whale swam on slowly as before, with sometimes the entire back and dorsal fin exposed or again with the top of the back only above the surface or just awash. Again they would swim along just under the surface. As observed by other writers, the body is but little arched and the tail does not appear during the short surface dives, but in the deeper dives, the body is much arched and the flukes are thrown out as the whale goes in a nearly perpendicular course downward. A remarkable series of photographs illustrating the appearance of the Pacific Humpback in its dives and surface movements has been published by R. C. Andrews (1909, Plates 30–36). There seems to be no definite number of spouts between the long dives. No doubt this may depend

in part on whether or not the whale is feeding and the depth to which it must go to obtain food.

The spout is of characteristic appearance. It issues as a single column, and at once expands to a broad balloon-shaped cloud, that shortly is dissipated in the air. This is quite different from the high narrow column of the larger Rorquals. Andrews (1909) considers that fifteen feet is a maximum height and ordinarily it seems less. The sound produced by the expulsion of the breath is described as a "metallic whistling" (Andrews) and Rawitz (1900) even supposes that this sound may be modulated so as to produce several different tones, but it may be doubted if this is an effect consciously produced, as that author seems to think. Racovitza (1903), who several times in the Antarctic seas stood almost over a Humpback spouting at the side of the vessel, testifies that the breath of the huge creature possesses a very nauseating odor, due possibly to mucous secretion of the nasal passages. Goodall (1913) who had an opportunity of seeing a wounded Humpback blow at a distance of about twenty feet, describes the fleshy ridge at either side of the blowholes as resembling lips. "In the act of expiration these 'lips' are erected on either side, and then directly after the inspiration they fall over the openings, and thus effectually close them."

Besides these characteristic movements accompanying the breathing and diving actions, the Humpback is noted for its lively manners in what seems to be play or excitement. Often they will thrust a large portion of the head obliquely out of the water. At other times, they turn on their side and show the pectoral fin or a fluke of the tail above water, especially in feeding. Rawitz states that in closing the huge mouth while feeding, the Humpback turns nearly over on its back, but Andrews does not corroborate this statement. At times this whale will thrust the flukes and a portion of the peduncle above the surface, and thrash the water into foam with powerful strokes, or the movement is less active (Andrews, 1909). This is the so-called 'lob-tailing.' More interesting still is the remarkable habit of jumping or 'breaching.' Andrews (1909) has lately observed these movements in the Pacific Humpback. He states that the whale usually emerges from the water in a nearly vertical position, coming out clear, so as to show even the tips of the flukes and invariably falls back upon its side with a great splash. Struthers (1889) writing of the Humpback killed in the Firth of Tay, Scotland, says that it rose, seemingly for two thirds of its length almost perpendicularly out of the water, flapped its enormous paddles, and then fell to one side. This it once did thrice in succession. At other times very little of this activity is shown, but the animals behave as calmly as a Finback. The tremendous size of the pectoral fins suggests some special use. It may be that they are used in swimming to propel the body, when, for example, the tail is above the surface. An analogy is suggested among the seals. For whereas the Harbor Seal with its short fore flippers, uses the hinder extremities for propulsion, the Sea Lion with its long fore limbs uses these instead, to row itself about. Observations on the use of the fore limbs in the Hump-

back are lacking, however. Rawitz (1900) supposes that the greater length of the paddles as compared with those of the Finbacks is an adaptation for turning the more unwieldy and slower-moving animal on its back, as it closes its jaws, but this seems unlikely.

The Whale and Swordfish Story.— The active movements of this species, when seen by the casual traveller at sea, are often mistaken for signs of a great conflict between sea monsters. Thus in our daily papers of late years it has become an almost regular feature of the early summer news to include a vivid account of a terrific battle viewed by the astonished passengers of some incoming steamer, in which the combatants are a whale and a swordfish. The honors of war are usually accorded to the latter, though occasionally the outcome is left uncertain. No doubt some of these tales have a basis of fact, and though reported in good faith, owe their inaccuracy to faulty observation. Such was probably the case with an account published in the Nantucket Inquirer and Mirror (vol. 89, no. 52, June 26, 1909), which, as a sample of the 'whale and swordfish' story, may be quoted in full. "A remarkable fight between monsters of the sea was witnessed by the passengers and crew of the steamer *Esparta*, which arrived at Boston from Port Limon, Costa Rica, on Monday.

"The thrilling battle occurred south of Nantucket South Shoal lightship, between a whale and another great fish believed to be a swordfish. The whale was vanquished.

"The whale was the only one of the two fighters visible to the passengers and crew. The great mammal lashed its tail violently, churning the waters into a mass of foam, while it was believed to be attacking the swordfish with its teeth. Several irregular plunges appeared to indicate a successful plunge by the fish beneath and finally the great whale was seen to throw its massive bulk clear of the water and then sink from sight. The water for a considerable distance about was dyed red with the blood, and it was believed the whale had received a mortal wound."

Several points at once appear wherein the facts given do not bear out the conclusions. "The whale was the only one of the two fighters visible," we are told, so that the main reason for assuming there was a fight at all was simply the active movement of the whale, which after a violent bit of 'lobtailing' finally leaped clear of the water and disappeared. Probably the real explanation of the whole occurrence, as first suggested by Scammon, is that a playful Humpback Whale was seen going through various antics after the habit of its kind, 'finning,' 'lobtailing' and 'breaching,' as described previously. To one ignorant of the habits of the Humpback, such agile movements on the part of so great a creature might easily seem to be the accompaniment of some terrific conflict with an unseen foe. The seas "dyed red with-blood," if not the result of an overwrought imagination, might be in part due to the presence of multitudes of the minute red crustaceans on which the whale feeds.

A few years ago the Boston Transcript printed a like report of a "sea battle" witnessed by passengers on the steamship *Cymric* when about a day's run from Boston. In this case the

two combatants were "an enormous whale and a thresher." "The whale could be seen to dive in the attempt to escape his tormentor, but the thresher was on him with agile leaps at every reappearance, and the water for yards around was stained with blood." The grain of truth in this and similar stories may be again the active movements of a Humpback Whale seen none too well by undiscriminating voyagers. Possibly, too, the attacker was a Killer Whale (Orcinus) and I suspect this may have been the case also in regard to an account given me in the Bahama Islands, 1904, by a friend who reported that the Resident Justice of Governor's Harbor, Eleuthera, had witnessed an encounter near that place, between a whale and a swordfish. The fierce Orca or Killer Whale is often called 'sword fish' (Norwegian 'sverdfisk') on account of its high dorsal fin, and is known at times to attack the larger whales. Although I have seen no trustworthy account of such a case, it is not to be assumed that the true swordfish (Xiphias) may not occasionally attack a whale. Thus a writer in the Philosophical Transactions of the Royal Society of London, in 1700 (see Abridgement, 1722, vol. 2, p. 843) in recording a dead Sperm Whale, cast on the New England coast, concludes that "it is not very improbable but that it may have been kill'd by a certain *Horny Fish*, which is said by Mr. Terrey, in his *East-Indian Voyage*, to run his Horn into the *Whale's* Belly; and which is known sometimes to run his Horn into Ships, perhaps taking them for *Whales*, and there snapping it asunder, as happened not long since to an *English* Vessel in the West-Indian Seas." That the swordfish will occasionally pierce the bottom of a pursuing boat is well known.

But tradition is old on this subject. Bartholomew Anglicus, a Franciscan of the middle of the thirteenth century, wrote a treatise De Proprietatibus Rerum, to explain the allusions to natural objects mentioned in the Scriptures. The sources of information for natural history were Aristotle and Pliny, and the work was one of the most widely read of mediaeval times. His version reads: "Also Jorath saith, that against the whale fighteth a fish of serpent's kind, and is venomous as a crocodile. And then other fish come to the whale's tail, and if the whale be overcome the other fish die. And if the venomous fish may not overcome the whale, then he throweth out of his jaws into the water a fumous smell most stinking. And the whale throweth out of his mouth a sweet smelling smoke, and putteth off the stinking smell, and defendeth and saveth himself and his in that manner wise." The "sweet smelling smoke" was perhaps the spout.

Voice.— Rawitz (1900) affirms that he was able to distinguish several different tones in the noise made by the spouting Humpback, due as he supposes, to the degree of tension stretching the nostrils as the breath is expelled. He believes that these different tones correspond to a voice, but the whole matter is much too uncertain to be accepted as established. A recent writer (F. A. Fenger, 1913, p. 671) testifies to a distinct sound produced as the Humpback rises through the water to the surface. When waiting for the appearance of a large bull Humpback, which was being pursued in an open boat among the Grenadines, "a low humming"

was heard which the whalers at once recognized as made by the animal. This author writes that it was clearly audible on placing his ear against the planking of the boat as "a distinct note like the low tone of a 'cello." It ceased abruptly as the whale broke water. A somewhat similar sound is said to be produced by the White Porpoise (Delphinapterus). There seems little likelihood that the sound is a conscious vocal utterance, but may be produced involuntarily through the effort of retaining the breath. Pulsations or vibrations thus caused, might be communicated in some way to the boat as a resonator.

Accompanying Vessels.—Moseley (1879) in his Notes by a Naturalist on the *Challenger*, speaks of a Humpback Whale that followed the vessel for several days in the South Pacific. Rear-Admiral John Schouler, U. S. N., informs me of a similar instance, where a large whale of unknown species accompanied his vessel from St. Paul's Island to the Brazilian coast, and was daily seen in constant attendance off the quarter or abeam. In Hakluyt's Voyages is a relation by Richard Fisher of the voyage of the ship *Marigold* to Cape Breton in which a whale, perhaps a Humpback or a Finback, attached itself to the explorers' vessel and kept it company for several days off southern Newfoundland. This incident is told in the quaint language of the time as follows. "One thing very strange hapened in this voyage: to witte, that a mightie great whale followed our shippe by the space of many dayes as we passed by Cape Razo [Cape Race, Newfoundland], which by no meanes wee could chase from our ship, untill one of our men fell overboard and was drowned, after which time shee immediately forsooke us, and never afterward appeared unto us." [1] Moseley believes that when porpoises or whales accompany a ship in this manner, they "think they are attending a larger whale."

Food.

So far as known, the Humpback feeds chiefly on the pelagic crustaceans, *Thysanoëssa inermis* and probably Meganyctiphanes, which it engulfs in quantities as it swims about in the plankton currents. According to Rawitz, it often turns more or less completely on its back when it closes its mouth in feeding on these small shrimp-like animals, but this is not always the case. It is probable that small fish form a part of the diet but exact observations are meager on this point. Guldberg (1887) states that on the Norwegian coasts they follow the great schools of capelin (Mallotus) that come inshore to spawn, and the same fish is eaten in the Newfoundland and Labrador waters where it abounds in summer. There seems to be no evidence that the Humpback eats herrings on our coast. Andrews (1909, p. 221) records of the Pacific Humpback (*M. versabilis*) that one killed in Alaskan waters contained "a great quantity of codfish (probably *Gadus macrocephalus*), the largest being about sixteen inches in

[1] Hakluyt, R. The principal navigations, voyages, traffiques and discoveries of the English nation. Everyman's Library editon, vol. 6, p. 96.

length." This must be very unusual, for as the same author states, the small schizopod crustaceans are all that are usually found in stomachs of this whale. Millais (1906, p. 181) is authority for the statement that it feeds also on squid. A curious case is mentioned by Johnston,[1] of a dead Humpback, thrown up on the shore near Berwick, England, in September, 1829. "On opening the stomach six cormorants were found in it, and another in the throat, so that it was presumed this Whale had been choaked in the attempt to swallow the bird."

Breeding Habits.

Practically nothing is known of the breeding habits of the Humpback on the New England coast. They are often seen in pairs, however, during the summer months, not only on our coasts but in more northern seas as well. Guldberg found them in pairs off the Norwegian coast in April and May, and Rawitz (1900) made a similar observation in mid-July. Mr. Owen Bryant saw numbers of them during a cruise from the Isles of Shoals to Nova Scotia, September 4–6, 1903, most of which were in pairs. It is supposed that copulation takes place during early summer and that pregnancy lasts about a year. The young are probably born in the spring therefore, but there is practically no exact information on this subject (Guldberg, 1887).

A single young one is produced at a birth as a rule, though twins are known in rare cases. Verrill (1902) mentions young Humpbacks 15 or 20 feet long in the Bermudan waters in February, and such were no doubt newly born. Goodall (1913) writing of the Humpback of the East African coast, tells of one killed in the act of parturition, whose calf measured sixteen feet in length and weighed two tons. The length of the mother is not given but assuming it to have been in the neighborhood of 48 feet, the length of the calf must have been a third that of its mother.

The affection of the mother for her young one is very strong. As with the Right Whale, she will not leave it if in danger, and the whalemen take advantage of this by killing first the young one, then attacking the devoted mother, who refuses to be driven off.

It is supposed that the young Humpbacks are born in the warmer waters to the south of our coasts. Mr. J. S. Wildman who has for some years carried on a fishery for this species in the Grenadines (B. W. I.), tells me that during the month of March it is common to see in those waters young calves accompanying a bull and cow Humpback. They seem to be at that time in passage and disappear by May. Possibly they follow the Gulf Stream northwards. Verrill's statement above quoted indicates that young are brought forth also in the seas about the Bermudas, though he adds (p. 274) that most of the young ones seen in those waters in spring are from twenty to thirty feet long, and so may very probably have been immature

[1] Trans. Nat. Hist. Soc. Northumberland, Durham, Newcastle upon Tyne, 1831, vol. 1, p. 7.

animals in passage, born in more southern waters. The young certainly accompany the mother for a considerable period, until they are upwards of thirty feet in length and probably, as the whalemen suppose, are 'yearlings,' a year or more old.

Longevity.

Nothing is known as to the age to which this whale may live. At least twenty years is probably not excessive, if we may credit Professor Verrill's (1902) account of a Humpback he saw with others in the Bay of Fundy about 1859. This particular specimen had a large barnacle so situated at the edge of its blowholes as to produce a characteristic whistling sound as the whale spouted. According to local fishermen the whale had been known by this mark for upwards of twenty summers. Assuming the truth of the observation, it implies a fairly long term of life for the barnacle, as well as a regularity of habit for the whale to return thus annually to the same waters.

Occurrence in New England Waters.

Although the Humpback sometimes comes very close inshore, it is very rarely indeed that one becomes stranded. Baird (Rept. U. S. Comm. Fish and Fisheries for 1879, 1882, p. xx) reports a 30-foot specimen that stranded in Provincetown Bay, and was secured for the U. S. National Museum. This is the only such occurrence known to me in New England, except the ancient report of one that was stranded in Nantucket Harbor in 1608, and killed by the Indians. Not uncommonly they will enter harbors or even go a short distance up the mouths of the large rivers. Thus there are records of Humpbacks entering the harbor at Nantucket, and of another that made its way up the Piscataqua River beyond the Portsmouth Bridge, N. H., nearly three miles from the sea. Again one was captured in Newport Harbor, and others are reported close inshore as in case of one seen near the rocky coast of Marblehead by Mr. H. L. Shurtleff in 1903. Two whales, probably Humpbacks, appeared in Portland Harbor, Maine, in 1908.

Usually, however, they keep well off shore, and most of the records seem to be of schools or small companies seen about Nantucket Shoals, on the Georges Banks, or off Provincetown and the outer parts of Massachusetts Bay.

In the following pages are gathered together such records as I have been able to find, published or unpublished, of the occurrence of the Humpback Whale in New England waters. Their comparatively meager number is unquestionably due, not to the scarcity of the species off our coasts, but to the few definite observations available, and the relatively small proportion of whales that are killed or stranded and reported. Fishermen off shore occasionally meet with the species and it is undoubtedly of much more regular occurrence than the few

records would seem to indicate. There is some evidence, too, that of late years the Humpbacks as well as the Finbacks have become fewer or have deserted these coasts. Such, at all events, is the observation of Captain H. L. Spinney whose great familiarity with the conditions about Cape Elizabeth lends weight to his statement that "with the driving away or extermination of the small fish" through over-fishing or other causes, "the whales have dropped out of notice." Indeed, he has seen no Humpbacks in local waters for twenty years past. Under the occurrence of the Finback, I have quoted further from Captain Spinney's letters to me on this matter.

In the table on page 309 I have summarized what definite records of New England Humpbacks I have found.

1757.— On November 5th, one Jasher Taylor of Yarmouth, Mass., made affidavit before the town clerk of having struck but lost a Humpback Whale, evidently near that shore.

1825.— About October 26th, a Humpback Whale came into the outer harbor at Nantucket, and was seen spouting, and throwing up its flukes as it dove. Although two boats were at once manned and sent in pursuit, the approach of night made it necessary to abandon the chase (Nantucket Inquirer, Oct. 31, 1825).

1827.— The Portsmouth Journal gives a detailed account of a whale that had gone up the Piscataqua River beyond the Portsmouth Bridge, N. H., about three miles from the sea, and seemed unable or unwilling to repass the bridge in order to reach the ocean again. It was finally attacked and killed by the citizens and brought to Portsmouth (Nantucket Inquirer, June 16 and 23, 1827). The ridge on the back and the crenulate outline of the flukes seem to identify it as a Humpback though allowance must be made for certain discrepancies in measurements given.

Two were killed on the Nantucket Shoals during the first ten days of August, by the sloop *Rapid* (Nantucket Inquirer, Aug. 11, 1827).

1836.— A note in the Providence Courier makes mention of a whale that had been seen several times off Newport, R. I., during the last of June. It was finally captured in Newport Harbor, "north of the Asylum; it measures fifty feet in length, and is of the Humpback species and is supposed to be the same which was seen off Pawtuxet on Wednesday morning last."

1840.— In December, 1840, a Humpback Whale, that made some fifty barrels of oil, was killed in Provincetown Harbor (Alexander Young: Chronicles of the Pilgrim Fathers, 1844, p. 119, footnote).

1841.— According to a report in the Boston Transcript, the steamer *Huntress* saw a large school of Humpbacks not far from Cape Elizabeth, Maine, about the first week in June (Nantucket Inquirer, vol. 21, no. 47, June 12, 1841). The boat passed close to one of about forty feet in length.

1844.— A skeleton, mounted and preserved in the Museum at Niagara Falls, New York,

was made by Cope (1865) the type of his *Megaptera osphyia*. The individual was found dead at sea off Petit Manan Lighthouse, Maine, in July of this year, and was towed to shore. The animal was said to have been fifty feet long.

1845.— What was doubtless a Humpback Whale, was killed off the coast of Maine in July, 1845, and its skeleton, "set up at much labor and expense," was exhibited in Boston shortly after. Dr. J. B. S. Jackson made it the subject of brief remarks at a meeting of the Boston Society of Natural History, August 20th, 1845. In the possession of 51 or 52 vertebrae and fourteen pairs of ribs, Dr. Jackson pointed out its agreement with Cuvier's "Rorqual du Cap," a Humpback of the South Atlantic. The specimen was 40 feet long, and a female, nearly adult (Proc. Boston Soc. Nat. Hist., 1845, vol. 2, p. 53).

1852.— A Humpback Whale was captured by a whaling schooner from Provincetown about the middle of June, some twenty miles southeast of Cape Elizabeth Light, Maine. It was towed to House Island and flensed. The yield of oil was estimated at forty barrels (Nantucket Inquirer, vol. 32, no. 73, June 21, 1852).

During the first three weeks of August six Humpbacks were killed by the schooner *Hamilton* of Nantucket on the Shoals. Five others were struck but lost (Nantucket Inquirer, vol. 32, no. 100, Aug. 27, 1852).

1859.— On April 22d, a dead Humpback was reported 20 miles south of Nantucket South Shoal by the ship *Richmond* from Savannah. The note adds that several Humpback Whales had been seen in Massachusetts Bay during the last week of April (Nantucket Inquirer, vol. 43, no. 32, April 29, 1859).

During late July and early August of this year, Professor A. E. Verrill, while engaged in marine investigations about Grand Manan, "personally observed large schools of Humpbacks, with some Fin-backs in the Bay of Fundy. They were especially numerous at the seining grounds known as the 'Ripplings,' east of Grand Manan Island, towards the center of the Bay, where the strong opposed tidal currents make a large area of very rough water during flood tide" (A. E. Verrill: The Bermuda Islands, 1902, p. 275).

1863.— During the last week of October of this year, "three large Humpback Whales" were seen on Nantucket Shoals by the crew of the schooner *Samuel Chase*. On learning of this, Captain Patterson of Nantucket set out in the *Rainbow* in the hope of making a capture but as nothing further is chronicled, he was probably unsuccessful (Nantucket Inquirer, vol. 43, no. 47, Oct. 31, 1863).

1877.— The Nantucket Inquirer and Mirror (vol. 58, no. 15, Oct. 31, 1877) relates a singular accident that befell a citizen who was coot shooting from a dory off Gunner's Point, South Plymouth, Mass., on October 30th. A Humpback Whale rose and spouted some distance off, and on again coming to the surface, it rose directly under the boat, oversetting it and tipping its occupant into the water. Fortunately he was quickly rescued by some men in another dory.

1878.— True (1904, p. 232) records a skeleton in the U. S. National Museum (no. 21492) from a whale killed at Cape Cod probably in this year.

1879.— On April 12th, a thirty-foot specimen stranded in Provincetown Bay. A cast was made of it for the U. S. National Museum and its skeleton is also preserved there (no. 16252) (S. F. Baird: Rept. U. S. Commr. Fish and Fisheries for 1879, 1882, p. xx). Two others were killed in the spring of this year in Provincetown Harbor by the use of bomb-lances (G. B. Goode: Fisheries and Fishery Industries of U. S., 1884, sect. 1, p. 27). In this year Humpbacks were abundant in summer off the Maine coast, and four were taken previous to September 1st, by a small schooner, the *Brilliant,* of Provincetown (*ibid.*).

1880.— In the spring of this year one was killed and brought into Bass Harbor, Maine (A. H. Clark in Goode's Fisheries and Fishery Industries of U. S., 1887, sect. 5, vol. 2, p. 40). Three others were killed during the spring and summer by Provincetown whalers in New England waters (*ibid.*, p. 42).

1881.— On May 14th, no less than twenty Humpbacks were shot with bomb-lances in Provincetown Harbor (G. B. Goode: Fisheries and Fishery Industries of U. S., 1884, sect. 1, p. 27).

1895.— About May 1st, a Humpback was wounded by Captain E. W. Smith, off Provincetown.

1903.— Mr. Owen Bryant tells me that during a cruise from the Isles of Shoals to Nova Scotia, September 4–6, he saw in all a hundred or more. They were mainly in pairs and perhaps mated at this time.

Mr. Howard L. Shurtleff gives me a note of a whale that was seen close to the Marblehead shore, Massachusetts, for an entire afternoon in early September. With a glass, he could see the barnacles on the whale as it came partly out of water, and noticed that in diving it threw its tail clear. These two facts seem to indicate that it was a Humpback.

1908.— Two whales that appeared in Portland Harbor, Maine, in July of this year, may have been Humpbacks. According to the newspaper report (Lewiston Journal) they were watched for some while "peacefully romping about" near Peak's Island, occasionally "flapping their huge tails out of water." The latter observation, if true, would seem to indicate Humpbacks.

1911.— A number of Humpbacks were seen on August 5th, by my friend, Dr. Charles W. Townsend, while off the Maine coast about an hour's voyage from Cape Ann, en route from St. John, N. B., to Boston. Occasionally five or six were seen close together, and when they sounded, their tails were lifted from the water in the characteristic manner.

1913.— About August 14th, Mr. Walter H. Rich observed numbers of Humpbacks off Sankoty Head, Mass.

Humpbacks in New England Waters.

Locality	Year	January	February	March	April	May	June	July	August	September	October	November	December
Off Yarmouth, Mass.	1757											1	
Nantucket Harbor, Mass.	1825										1		
Piscataqua River, N. H.	1827						1						
Nantucket Shoals	1827								2				
Off Newport, R. I.	1836						1						
Provincetown Harbor, Mass.	1840												1
Off Cape Elizabeth, Me.	1841						n						
Off Petit Manan Lighthouse	1844						1						
Maine Coast	1845						1						
Off Cape Elizabeth, Me.	1852						1						
Nantucket Shoals	1852								11				
Nantucket Shoals	1859				1								
Massachusetts Bay	1859				n								
Bay of Fundy	1859							n	n				
Nantucket Shoals	1863										3		
Off South Plymouth, Mass.	1877										1		
Provincetown Bay, Mass.	1879				1								
Near Bass Harbor, Me.	1880				spring and summer								
Provincetown Harbor, Mass.	1881					20							
Off Provincetown, Mass.	1895					1							
Gulf of Maine	1903									100±			
Marblehead, Mass.	1903									1			
Portland Harbor, Me.	1908							2					
Off Cape Ann, Mass.	1911								n				
Off Sankoty Head, Mass.	1913								n				
		0	0	0	2+1n	21+	5+1n	2+1n	13+3n	101±	5	1	1

The table brings out rather strikingly that so far as the evidence goes, the Humpback is practically absent from our coast in winter. There are no records for January, February, or March, and but one each for November and December. They begin to appear in April and may be common during the summer, but after September or October again disappear. It is noticeable that the larger schools of them are usually seen well off shore, and that those seen nearer the mainland are usually solitary individuals. Captain H. L. Spinney writes me (1913) that during his observations in the region about Cape Elizabeth, Maine, covering forty years past, he used to see Finbacks and Humpbacks, particularly the former, at least from April to November, but that July and August were the months when they were seen in greatest numbers. This corroborates the table, and indicates that the Humpback is a spring and summer visitor with us.

These facts lead us to inquire further into the movements of the Humpback in the North Atlantic. Guldberg (1904, p. 376) has summarized a number of observations bearing on the movements of Humpbacks on the European coasts, Greenland and adjacent seas. He concludes that the Humpbacks of the North Atlantic frequent the higher latitudes in summer and fall, and for the rest of the year scatter in the search for better feeding grounds, which for the most part they find in the more southern latitudes. It is certain that our present knowledge on this matter is quite insufficient for more than tentative conclusions. In the western North Atlantic, however, I have gathered a number of facts as to the presence of this species, which may be briefly summarized. In late winter, especially in February and March, Humpbacks are found with young calves among the islands of the Lesser Antilles and the Bermudas. Among the Grenadines (Lesser Antilles) the Humpback fishery is followed from January to May, during which time, single whales, cows with calves, and groups consisting of a pair with a calf, are to be found. Verrill records that among the Bermudas the Humpbacks were found in the same months with young calves and in former days were actively pursued there. They begin to appear off the New England coasts in April, are common here in summer, and reach the coasts of Newfoundland in numbers by late April, May, and June. By late summer they penetrate Davis Strait and Baffin's Bay on the South Greenland coast. Guldberg says that from January to April 19, 1902, only five were killed on the Newfoundland coasts by the steam-whalers, but from that date till the end of August about a hundred were captured. These facts tend to show that during the colder months, December through March, most of the Humpbacks of the western North Atlantic are to be found inside (south of) the Gulf Stream area, and that their young are born in those warmer waters. They are not necessarily in coastal waters at these times, for I have records of Humpbacks, March 28th and March 29th, near 27° 11′ N., 50° 07′ W., and 26° 38′ N., 48° 58′ W., respectively, a pair in each case. By April they work north. Those in the Caribbean Sea have left it by May, and those that wintered farther north (as we may suppose) are already appearing on the New England coasts. The northward movement continues till late summer, when there is a withdrawal to the Gulf Stream waters and southward to the sub-tropics. No doubt, as with migrating birds, this is a gradual process and it may be that those animals that wintered farthest north, are the ones to reach our coast first and that they are the same schools that push to the higher latitudes and the Greenland waters, while those that wintered farthest south spend the summer in our waters. As with birds, also, there are always a few stray individuals that from accident or choice find it possible to winter to the north of the general winter range of the species, so that it is not surprising to find a few even on the Newfoundland coast in the cold months. These we should expect to be nonbreeding cows or bulls. It is known also that they may be present in the Finmark waters in February and March.

What determines these migratory movements is yet uncertain. Temperature undoubtedly

is a factor, but probably an indirect one, in having an influence on the food supply. Not unlikely, too, is the supposition that the warmer southern waters are more tolerable for the newly born young.

Of the return movement in fall there is very little actual knowledge. Verrill speaks of a large school, presumably of Humpbacks, seen on October 23, 1879, off the Bermudas, and supposes they were in passage southward.

Humpback Whale Fishery in New England.

The first recorded capture of the Humpback Whale in New England seems to have been in 1608, according to Clark[1] "when a party of Indians killed a humpback whale which got stranded on a part of Nantucket, called Caton, in the inner harbor." For the first century or more during which our forefathers pursued the shore fishery on these coasts, the Right Whale was the chief object of the industry. Occasionally an attempt was made to kill a Finback if some favorable chance offered, but the Humpback Whale being somewhat more sluggish and less powerful than the swift Finback Whales, and yielding more oil in proportion, was undoubtedly killed in small numbers. Of this, however, there is little actual record. Freeman in his History of Cape Cod (1862, vol. 2, p. 218) mentions the following entry by the Town Clerk of Yarmouth in the town records: "I, Jasher Taylor, Nov. 5, 1757, struck a hump-back whale on the back, about two yards past the fin,— the iron, with a thick head and short warp, not marked." This record was of course made in accordance with a regulation passed a number of years previously, requiring persons who struck and lost a whale, to make this form of affidavit immediately thereafter, so as to avoid controversy concerning ownership, should the whale subsequently drift ashore dead. "Craft [*i. e.*, whaling implements] claims the whale" has ever been an unwritten law among whalemen.

With the decrease in numbers of the Right Whale on our coasts, the Humpback seems to have been more frequently pursued during the eighteenth century by vessels making short cruises from Nantucket or the Cape Cod towns. The Nantucket Shoals and George's Banks were favorite 'grounds' for this fishery, which seems often to have been combined with cod-fishing.

The American Revolution placed a temporary check upon the progress of offshore whaling, as our vessels were ever liable to capture by the English privateers and men-o'-war. To the Nantucketers, then largely dependent on this means of livelihood, it became therefore a serious matter, and in 1781, we find them approaching Admiral Arbuthnot, at that time in command of the English navy in American waters, with a petition to be allowed to carry on their whaling operations unmolested. This request was generously granted, but so impoverished had the

[1] Clark, A. Howard, in Goode's Fisheries and Fishery Industries of U. S., 1887, sect. 5, vol. 2, p. 30.

islanders become by reason of the war, that few were able to make much avail of the privilege. After the Revolution and until the War of 1812, the New England whalers continued to take Humpbacks on the shoals to the eastward of Nantucket, where, according to Macy,[1] these as well as codfish, "were plenty, which gave encouragement to many, who would otherwise have been idle, to engage in the pursuit of them. But unfortunately a privateer came among the fleet, and took several vessels, one of which belonged to Nantucket." This seems to have again placed a temporary check upon whaling in home waters.

Although the Revolution and the War of 1812 nearly destroyed the American whaling industry, it soon regained its place and in the decade following 1835 was at the height of its importance. But it was now concerned chiefly with long voyages to distant seas or often around the globe, so that we have little record of what few whales were taken on our coast. No doubt, however, an occasional Humpback was killed by fishermen in boats from the shore or more often from their fishing vessels on the Shoals.

In his article on the fisheries of Massachusetts, Clark[2] writes that "Mr. Elisha Atwood.... informed me that seventy-five or eighty years ago [*i. e.*, 1805–1810], there were four captains, each, with his vessel, employing fourteen hands, hailing from Wellfleet. They went to Labrador for right-whale, Mount Desert and vicinity for humpback-whale, and the West Indies for sperm-whale. There were watchers on the shore who signalled to the whalemen the appearance of a whale in the bay [Provincetown Bay]. These men would then go out after it and tow it inshore to the islands, where the oil was tried out. There is no whaling from Wellfleet now. Fifty-five years ago [*i. e.*, about 1830] the whale-oil trying on Griffin's Island and Bound Brook Island [Truro, Mass.] came to an end. Just prior to this sixteen persons were employed. Ten or twelve years ago [1877 or 1875] the last vessel was fitted out for the West Indies, but proved a failure." Captain N. E. Atwood of Provincetown is authority for the statement that "a great many [Humpbacks] have been killed near Provincetown within his recollection: that is to say, or since 1817. One harpooned in the harbor in 1840 yielded fifty-four barrels of oil. Two were killed in the spring of 1879, with bomb-lances."[3]

The Nantucket Inquirer of August 11, 1827, notes the arrival at that port of the sloop *Rapid*, Captain Myrick, from a whaling excursion of ten days "over the shoals." Two Humpbacks constituted the catch. These had been taken "about 20 miles eastward of this island, in 18 fathoms of water. The blubber....was peeled off immediately in large 'blanket pieces,' or flakes, about 10 feet in length, two or three feet wide, and from 4 to 10 inches in thickness. The mass thus stripped from the carcasses, nearly filled the vessel's hold; and will probably produce 50 barrels of oil worth 38 to 40 cents per gallon." The practice of stripping the blubber

[1] Macy, Obed. History of Nantucket, 1835, p. 174.
[2] Clark, A. Howard, in G. B. Goode's Fisheries and Fishery Industries of U. S., 1887, sect. 2, p. 235.
[3] Goode, G. B. Fisheries and Fishery Industries of U. S., 1884, sect. 1, p. 27.

at sea and bringing it ashore to try out the oil in the vats there seems to have been generally followed on the Massachusetts coasts at this time.

In these years too (from 1810 to about 1840) Humpback Whales were undoubtedly the chief object of the Maine shore-fishery, an account of which is given by Earll and Clark,[1] as follows: "Capt. J. Bickford, a native of Winter Harbor, is reported by Mr. C. P. Guptil to have cruised off the coast in 1845 in schooner *Huzza*, and to have captured eight whales, one of which was a finback, the rest humpback whales. This schooner made only one season's work.... Mr. Earll states that according to Capt. George A. Clark and Captain Bickford whaling was extensively carried on from Prospect Harbor, [Maine] for many years. The fishing began about 1810, when Stephen Clark and Mr. L. Hiller, of Rochester, Mass., came to the region, and built tryworks on the shore, having their lookout station on the top of an adjoining hill. The whales usually followed the menhaden to the shore, arriving about the first of June and remaining till September. When one was seen the boats, armed with harpoons and lances, immediately put out from the land and gave chase. If they succeeded in killing the whale, it was towed to the flats of the harbor at high water, where it was secured and left to be cut up at low tide. Ten years later they began using small vessels in the fishery, and by this means were enabled to go farther from land. The fishery was at its height about 1835 to 1840, when an average of six or seven whales was taken yearly. The largest number taken in any one season was ten. The average yield of oil was 25 to 30 barrels for each whale. The business was discontinued about 1860, since which date but one or two whales have been taken." The skeleton of a Humpback, probably one of those killed by the *Huzza* in July, 1845, was mounted and exhibited in Boston that summer.[2]

The specimen found dead in July, 1844, off Petit Manan Lighthouse, and later made by Cope (1865) the type of his *Megaptera osphyia*, was perhaps also killed by the shore whalers. The same account says that "shore-whaling in the vicinity of Tremont, [Maine,] began about 1840. Mr. Benjamin Beaver and a small crew of men caught three or more whales annually for about twenty years, but gave up the business in 1860. No more whales were taken from this time to the spring of 1880, when one was taken and brought into Bass Harbor, and yielded 1,200 gallons of oil [38 barrels], but no bone of value." Of the whales captured during these years, a few were probably Finbacks, but there can be little doubt (from the time of year, amount of oil, and the fact that Finbacks were generally unmolested) that Humpbacks were the species chiefly sought. Apparently no other regular efforts were made to capture Humpbacks on the Maine coast until the eighties, when small steamers with bomb guns probably took a few together with Finbacks.

[1] Clark, A. Howard. The Whale Fishery, in Goode's Fisheries and Fishery Industries of U. S., 1887, sect. 5, vol. 2, p. 40.

[2] Jackson, J. B. S. Proc. Boston Soc. Nat. Hist., 1845, vol. 2, p. 53.

On the Massachusetts coast, however, there was still more or less fishing for these whales from time to time, and "humpbacking on the Shoals" was probably the frequent resort of many a Nantucket or Cape Cod fisherman in the years preceding 1850. A writer in the Nantucket Inquirer of 1874, recalls the days of his boyhood, "when we were often made glad by the arrival of a fortunate 'humpbacker,'" for the crisp bits of "flukes and scraps" resulting from the trying out of the blubber on shore, were perquisites highly esteemed by the childish fancy. In a more or less desultory sort of way this pursuit of Humpback Whales was kept up, even to the time of the Civil War. Thus an item in the Nantucket Inquirer (vol. 32, no. 100, Aug. 27, 1852) records the arrival at that port of the schooner *Hamilton*, which during the first three weeks of August, 1852, had been cruising on the "Shoals" for Humpbacks. In this time, eleven had been struck, of which six were "saved" and produced 130 barrels of oil. This, the account states, was the *Hamilton's* second successful cruise, but whether in the same or the previous season, is not clear. On the first cruise the amount of oil secured was but sixty barrels. In the same year, the Nantucket Inquirer (vol. 32, no. 121, Oct. 13, 1852) notes that the schooner *Union*, of Provincetown, "recently captured a whale off Cape Ann, which is the second one that has been taken in that locality within the past few days." Judging from the time of year, these may have been Humpbacks. In 1854, the schooner *Wm. P. Dolliver* started in early July for "a whaling cruise on the Shoals," but when only a short distance out from Nantucket Harbor, shot a Finback with a bomb-lance and put back with the prize. Again the discovery of three Humpback Whales "on the Shoals" late in October, 1863, was considered sufficient inducement for one of the Nantucket captains to set sail shortly after in pursuit, but with what result does not appear (Nantucket Inquirer, vol. 43, no. 47, Oct. 31, 1863).

With the general introduction of the bomb-lance and the renewed activity in shore whaling by means of small steamers, a great many whales were killed in New England waters during the '70's and '80's, but what proportion of these were Humpback Whales cannot now be ascertained. Mr. J. Henry Blake gives me a note of one taken in Cape Cod Bay in 1875, by Jesse Glenn of the schooner *Starlight*. "Two were killed in the spring of 1879, with bomb-lances" near Provincetown.[1] In this same year "the Humpbacks were abundant on the coast of Maine. One of the most successful whalers out of Provincetown this season is the '*Brilliant*,' a very old pink-stern schooner of seventeen tons, which had been hunting this species off Deer Isle, Maine. Up to September 1, she had taken four whales, yielding one hundred and forty-five barrels. The '*Brilliant*' carries but one whale-boat and tries out the oil upon shore, towing in the whales as they are killed."[1] Of the hundred or more whales killed in our waters by Provincetown whalers in 1880, but three were said to be Humpbacks, the rest "of the finback species."[2] In the following year, however, no less than twenty Humpbacks were shot with bomb-lances in Provincetown Harbor on May 14th; doubtless others were killed at this time.

[1] Goode, G. B. Fisheries and Fishery Industries of U. S., 1884, sect. 1, p. 27.
[2] Clark, A. Howard. In G. B. Goode's Fisheries and Fishery Industries of U. S., 1887, sect. 5, vol. 2, p. 42.

A clipping from the Provincetown Beacon, kindly loaned me by Mr. J. Henry Blake, states that a Humpback was wounded about the first of May, 1895, by Capt. "Ed. Walter" Smith, a Provincetown whaler. After this year the shore whaling with small steamers was abandoned by the New England fishermen.

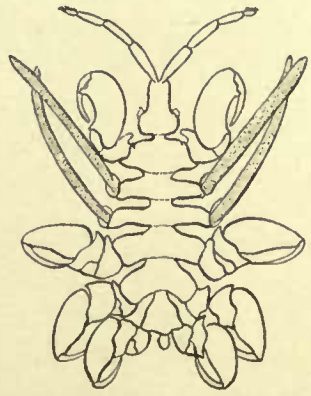
Yield of Oil.

The amount of oil yielded by the Humpback Whale is given by Goode [1] as averaging from twenty-five to thirty barrels. This is the yield under the old method of trying out the blubber alone. The modern practice of trying out the entire carcass affords a greater return of oil, but that from the flesh and bones is inferior. The specimen previously mentioned that gave 54 barrels must have been unusually fat. The average of fourteen Humpbacks, the totals of which have just been given, was 33.3 barrels each. The oil is not distinguished commercially from that of the Balaenopterae.

The whalebone is short and coarse-grained and in former times was thrown away by the fishermen along with the rest of the carcass after stripping the blubber. At the present time, however, it is carefully saved and sold with that of Finbacks and Blue Whales by the whaling companies of Newfoundland and the northern European coasts.

Enemies and Parasites.

It is not known that the Humpback has much to fear from predacious sea animals. As before mentioned, the Killer Whale no doubt at times attacks a larger whale, but there are few authentic data on this point. That the swordfish may attack a whale is also not impossible, and if tradition may be believed, it has occasionally happened. Such instances must be very rare, however.



TEXT-FIG. 12.—Whale louse (*Paracyamus boopis*), a crustacean parasitic on the Humpback Whale (after Lutken, 1873, Plate 3, fig. 6).

Of external parasites, the Humpback is the host of a most characteristic barnacle, Coronula, which has become remarkably adapted for attachment to the exterior of the whale through the lobular outpocketings of the valves of its shell, whereby it is firmly embedded in the whale's integument. These barnacles occur particularly at the symphysis of the jaw, and along the knobs on the outer edge of the pectorals, on the rough tubercles of the head, and sometimes about the anus or scattered on the ventral part of the abdomen. The whalemen commonly believe that the lively antics of the Humpback are the result of its efforts to get rid of these parasites. Darwin, in his Monograph of the Cirripeds, recognizes three

[1] Goode, G. B. Fisheries and Fishery Industries of U. S., 1887, sect. 5, vol. 2, p. 40.

living species of the genus Coronula. Pilsbry, in his monograph just issued, has extended our knowledge of these, and has established the fact that two species occur as parasites or commensals on the Atlantic Humpback. Of these *C. diadema* is the most common, and is found only slightly imbedded in the whale's skin, particularly on the front edge of the pectoral flipper, about the anus and flukes. It is known from the North Pacific as well as from the North Atlantic, but not as yet from the South Atlantic. The second species, *C. reginae*, has a similar range, so far as known. It is found on the *lips* of the Humpback, where the skin is thin, and here its more flattened shell grows deeply imbedded, so that only the summit is seen. Van Beneden (1890) recorded it from the Gulf of St. Lawrence. The third species, *C. complanata*, is somewhat like the last. Its only North Atlantic record seems to be that of Pilsbry, based on a specimen in the Paris Museum, from Norway.

Attached to the large Coronulae, are often to be found clusters of a second species of barnacle, the long-stalked *Conchoderma auritum*. This species is cosmopolitan, and is not usually attached to the Humpback except in this secondary way.

A third species of crustacean, the whale-louse, an aberrant amphipod, is also found clinging by its hook-like legs, to the rugosities or between the throat plaits of this whale. It is considered to represent a genus distinct from that found on the North Atlantic Right Whale, and is known as *Paracyamus boopis* (Lütken). An outline figure of this species, taken from Lütken's paper, is here shown (text-fig. 12). According to Mörch (1911) the curious crustacean Penella is occasionally found attached to the Humpback. No doubt also the small parasitic copepod Balaenophilus will be found attached to the baleen plates, but I know of no record for it in this species. The internal parasites likewise remain quite unknown, though one or more species of cestodes doubtless are present in the intestinal tract.

LITERATURE.

Abel, O.

1908. Die Morphologie der Hüftbeinrudimente der Cetaceen. Denkschr. K. Akad. Wiss. Wien, math.-nat. Kl., vol. 81, p. 139–195, 56 figs.

Allen, J. A.

1869. Catalogue of the mammals of Massachusetts: with a critical revision of the species. Bull. Mus. Comp. Zoöl., vol. 1, p. 143–252.

1908. The North Atlantic Right Whale and its near allies. Bull. Amer. Mus. Nat. Hist., vol. 24, p. 277–329, pl. 19–24.

Andrews, R. C.

1908. Notes upon the external and internal anatomy of *Balaena glacialis* Bonn. Bull. Amer. Mus. Nat. Hist., vol. 24, p. 171–182, text-fig. 1–6.

1909. Observations on the habits of the Finback and Humpback Whales of the eastern North Pacific. Bull. Amer. Mus. Nat. Hist., vol. 26, p. 213–226, pl. 30–40.

1909a. Further notes on *Eubalaena glacialis* (Bonn.). Bull. Amer. Mus. Nat. Hist., vol. 26, p. 273–275, pl. 46–50.

1916. Monographs of the Pacific Cetacea. II.— The Sei Whale (*Balaenoptera borealis* Lesson). 1. History, habits, external anatomy, osteology, and relationship. Mem. Amer. Mus. Nat. Hist., new ser., vol. 1, pt. 6, p. 289–388, pl. 29–42, 38 text-figs.

Beneden, P. J. van.

1859. Note sur une nouvelle espèce de distome, le géant de sa famille, habitant le foie d'une baleine, nommée *Distoma goliath*, V. Ben. Bull. Acad. Roy. Belg., Bruxelles, ser. 2, vol. 5, p. 231–233, 1 pl.

1868. Les squelettes de cétacés et les musées qui les renferment. Bull. Acad. Roy. Belg., Bruxelles, ser. 2, vol. 25, p. 88–125. (An attempt to list the preserved specimens of Cetacea.)

1869. Les baleinoptères du nord de l'Atlantique. Bull. Acad. Roy. Belg., Bruxelles, ser. 2, vol. 27, no. 4, p. 285–291, 1 pl.

1880. [On a Eubalaena killed at Charleston, S. C.] Bull. Acad. Roy. Belg., Bruxelles, ser. 2, vol. 49, p. 313–315.

1885. Sur l'apparition d'une petite gamme de vraies baleines sur les côtes est des États-Unis d'Amérique. Bull. Acad. Roy. Belg., Bruxelles, ser. 3, vol. 9, p. 212–214.

1886. Histoire naturelle de la baleine des Basques (*Balaena biscayensis*). Bull. Acad. Roy. Belg., Bruxelles, ser. 3, vol. 38, p. 1–44.

1887. Histoire naturelle des balénoptères. Mém. Couronnés et autres Mém. Acad. Roy. Belg., Bruxelles, vol. 41, p. 1–145.

1890. Une coronule de la baie de Saint-Laurent. Bull. Acad. Roy. Belg., Bruxelles, ser. 3, vol. 20, p. 49–54, 1 pl.

Bigelow, H. B.

1914. Explorations in the Gulf of Maine, July and August, 1912, by the U. S. Fisheries schooner *Grampus*. Oceanography and notes on the plankton. Bull. Mus. Comp. Zoöl., vol. 58, p. 29–147, pl. 1–9.

Borgström, E.

1892. Ueber *Echinorhynchus turbinella, brevicollis* und *porrigens*. Bihang till K. Svenska Vet.-Akad. Handlingar, vol. 17, part 4, no. 10, 60 pp., 4 pls.

Braun, M.

1904. Ueber Wale und ihre Parasiten. Bericht über Sitzungen, in Schriften d. Physikalisch-oeconomisch. Ges. Königsberg, vol. 45, p. 71–79.

Brown, Robert.

1868. Notes on the history and geographical relations of the Cetacea frequenting Davis Strait and Baffin's Bay. Proc. Zool. Soc. London, 1868, p. 533–556.

Buchet, Gaston.

1895. De la baleine des Basques dans les eaux islandaises et de l'aspect des grands cétacés à la mer. Mém. Soc. Zool. de France, vol. 8, p. 229–231, pl. 6–8.

Carte, Alexander, and Macalister, Alexander.

1868. On the anatomy of *Balaenoptera rostrata*. Phil. Trans. Roy. Soc. London, 1868, p. 201–261, pl. 4–7.

Cocks, A. H.

1887. The finwhale fishery of 1886 on the Lapland coast. Zoologist, ser. 3, vol. 11, p. 207–222.

Collett, Robert.

1886. On the external characters of Rudolphi's Rorqual (*Balaenoptera borealis*). Proc. Zool. Soc. London, 1886, p. 243–265, pl. 25–26, text-fig. A–G.

1909. A few notes on the whale *Balaena glacialis* and its capture in recent years in the North Atlantic by Norwegian whalers. Proc. Zool. Soc. London, 1909, p. 91–98, pl. 25–27.

Cope, E. D.

1865. Note on a species of Hunchback Whale. Proc. Acad. Nat. Sci. Phila., 1865, p. 178–181. (Description of *Megaptera osphyia* from Maine.)

De Kay, J. E.

1842. Zoology of New-York, or the New-York fauna.....Mammalia. Nat. Hist. of New York, part 1, xv + 146 pp., 33 pls.

Delage, Yves.

1885. Histoire du *Balaenoptera musculus* échoué sur la plage de Langrune. Arch. de Zool. Exp. et Gén., ser. 2, vol. 3 *bis*, suppl., art. 1, 152 pp., 20 pls.

Dubar, F.

1828. Ostéographie de la baleine échouée à l'est du port d'Ostende le 4 novembre 1827; précédée d'une notice sur la découverte et la dissection de ce cétacée. Bruxelles: 64 pp., 13 pls.

Dudley, Paul.

1734. An essay upon the natural history of whales,with a particular account of the ambergris, found in the Sperma Ceti whale. Phil. Trans. Roy. Soc. London, Abridgement, vol. 7, pt. 3, p. 424–431. See Phil. Trans., 1725, for original paper.

Dwight, Thomas.

1872. Description of the whale (*Balaenoptera musculus* Auct.) in the possession of the Society: with remarks on the classification of Fin Whales. Mem. Boston Soc. Nat. Hist., vol. 2, p. 203–230, pls. 6, 7, text-fig. 1–11.

Egede, Hans.

1745. A description of Greenland. Shewing the natural history, situation, boundaries, and face of that country; etc. (Translated from the Danish.) London: xx + 220 pp., illus.

Eschricht, D. E.

1849. Zoologisch-anatomisch-physiologische Untersuchungen über die nordischen Wallthiere. Leipzig: 4to, xvi + 206 pp., 14 plates.

1860. Mémoire sur les baleines franches du golfe Biscayen. Rev. et Mag. de Zool., ser. 2, vol. 12, p. 227–230.

Fabricius, Otho.

1780. Fauna Groenlandica, systematice sistens animalia Groenlandiae occidentalis hactenus indagata, etc. Copenhagen and Leipsic: xvi + 452 pp., 1 pl.

1818. Om Stub-Hvalen, *Balaena boops*. K. Dansk. Vid.-Selsk. Skrift., vol. 6, p. 63 (not seen).

Fenger, F. A.

1913. 'Longshore whaling in the Grenadines. Outing Mag., 1913, p. 664–679.

Flower, W. H.

1864. Notes on the skeletons of whales in the principal museums of Holland and Belgium, with descriptions of two species apparently new to science. Proc. Zool. Soc. London, 1864, p. 384–420, fig. 1–17.

Gasco, F.

1879. Il balenotto catturato nel 1854 a San Sebastiano (Spagna) (*Balaena biscayensis*, Eschricht) per la prima volta descritto. Ann. Mus. Civ. Stor. Nat. Genova, vol. 14, p. 573–608.

Gervais, Paul.

1864. Cétacés des côtes françaises de la Meditérranée. Comptes Rendus Acad. Sci. Paris, vol. 59, p. 876–881.

1871. Remarques sur l'anatomie des cétacés de la division des Balénidés tirées de l'examen des pièces relatives à ces animaux qui sont conservées au Muséum. Nouv. Arch. Mus. d'Hist. Nat. Paris, vol. 7, p. 65–146, pl. 3–10.

Goodall, T. B.

1913. With the whalers at Durban, and a few notes on the anatomy of the Humpback Whale (*Megaptera boops*). Zoologist, ser. 4, vol. 17, p. 201–121, pl. 1.

Guldberg, G. A.

1885. On the existence of a fourth species of the genus Balaenoptera. Journ. Anat. and Phys., vol. 19, p. 293–302.

1886. Bidrag til Cetaceernes Biologi. Om Forplantningen og Draegtigheden hos de nordatlantiske Bardehvaler. Forhandl. Vid.-Selsk. Christiania for 1886, no. 9, 56 pp.

1887. Zur Biologie der nordatlantischen Finwalarten. Zool. Jahrbücher, vol. 2, p. 127–174.

1891. Bidrag til nøiere Kundskab om Atlanterhavets Rethval (*Evbalaena biscayensis*, Eschricht). Forhandl. Vid.-Selsk. Christiania, 1891, no. 8, 14 pp.

1903. Ueber die Wanderungen verschiedener Bartenwale. [1.] Biol. Centralbl., vol. 23, p. 803–816.

1904. Ueber die Wanderungen verschiedener Bartenwale. [2.] Biol. Centralbl., vol. 24, p. 371–396.

1904a. Die Waltiere des Königsspiegels. Zool. Annalen (Würzburg), vol. 1, p. 29–40.

1907. Ueber das Verfahren bei Berechnung des Rauminhaltes und Gewichtes der grossen Waltiere. Forhandl. Vid.-Selsk. Christiania for 1907, no. 3, 12 pp.

Hamilton, J. E.

1915. Report to the Committee .... appointed to investigate the biological problems incidental to the Belmullet Whaling Station. Rept. 84th Meeting British Assn. Adv. Sci., 1914, p. 125–161, pls. 3, 4, 2 text-figs.

1916. Report, in Report of the Committee .... appointed to investigate the biological problems incidental to the Belmullet Whaling Station. Rept. 85th Meeting British Assn. Adv. Sci., 1915, p. 124–146, 4 text-figs.

Haupt, Paul.

1907. Jonah's Whale. Proc. Amer. Phil. Soc., vol. 47, p. 151–164.

Holder, J. B.

1883. The Atlantic Right Whales: A contribution, embracing an examination of I. The exterior characters and osteology of a cisarctic Right Whale — male. II. The exterior characters of a cisarctic Right Whale — female. III. The osteology of a cisarctic Right Whale — sex not known. To which is added a concise resumé of historical mention relating to the present and allied species. Bull. Amer. Mus. Nat. Hist., vol. 1, p. 99–137, pl. 10–13.

Japha, Arnold.

1905. Ueber den Bau der Haut des Seihwales (*Balaenoptera borealis*, Lesson). Zool. Anzeiger, vol. 29, p. 442–445.

1911. Die Haare der Waltiere. Zool. Jahrbücher, Abth. f. Anat., vol. 32, pt. 1, p. 1–43, pl. 1–3, 4 text-figs.

Knox, Robert.

1833–4. Account of the dissection of a young rorqual, or short whalebone whale, (the *Balaena rostrata* of Fabricius); with a few observations on the anatomy of the foetal Mysticetus. Proc. Roy. Soc. Edinburgh, vol. 1, p. 63–65.

Kükenthal, Willy.

1893. Vergleichend-anatomische und entwickelungsgeschichtliche Untersuchungen an Walthieren. Denkschr. Med.-Nat. Ges. Jena, vol. 3, x + 448 pp., 25 pls., 124 text-figs.

Kunze, A.

1912. Ueber die Brustflosse der Wale. Zool. Jahrbücher, Abt. f. Anat., vol. 32, p. 577–651, pl. 33–35.

Lillie, D. G.

1910. Observations on the anatomy and general biology of some members of the larger Cetacea. Proc. Zool. Soc. London, 1910, p. 769–792, pl. 74, text-fig. 69–78.

Lilljeborg, Wilhelm.

1867. On two subfossil whales discovered in Sweden. Nova Acta Soc. Sci. Upsala, ser. 3, vol. 6, no. 6, 48 pp., 11 pls.

Lindsay, D. M.

1911. A voyage to the Arctic in the whaler *Aurora*. Boston: 8vo, p. i–ix, 11–223, illus.

Lönnberg, Einar.

1892. Anatomische Studien ueber skandinavische Cestoden. II. Zwei Parasiten aus Walfischen und zwei aus *Lamna cornubica*. Kongl. Svenska Vet.-Akad. Handl., vol. 24, no. 16, p. 1–28, 1 pl.

1910. The pelvic bones of some Cetacea. Arkiv för Zoologi, vol. 7, no. 10, 15 pp., 12 figs.

Low, A. P.

1906. Report on the Dominion Government Expedition to Hudson Bay and the Arctic Islands on board the D. G. S. *Neptune*, 1903–1904. Ottawa: 8vo, xviii + 355 pp., illus. (Chapter 10, Whaling.)

Lütken, C. F.

1873. Bidrag til Kundskab om Arterne af Slaegten Cyamus Latr. eller Hvallusene. Vidensk. Selsk. Skr., Kjobenhavn, ser. 5, vol. 10, no. 3, p. 229–284, +i–iii, pl. 1–4.

Malm, A. W.

1867. Monographie illustrée du baleinoptère trouvé le 29 Octobre 1865 sur la côte occidentale de Suède. Stockholm: 4to, xxvi + 110 pp., 20 pls., 3 text-figs.

Millais, J. G.

1906. The mammals of Great Britain and Ireland. Vol. 3. London: 4to, xii + 384 pp., illus.

Mörch, J. A.

1911. On the natural history of whalebone whales. Proc. Zool. Soc. London, 1911, p. 661–670, text-fig. 160–163.

Moseley, H. N.

1879. Notes by a naturalist on the '*Challenger*,' being an account of various observations made during the voyage of H. M. S. '*Challenger*' round the world, in the years 1872–1876. London: xvi + 620 pp., illus.

Murie, James.

1865. On the anatomy of a fin-whale (*Physalus antiquorum*, Gray) captured near Gravesend. Proc. Zool. Soc. London, 1865, p. 206–227, text-fig. 1–4.

Perrin, J. B.

1870. Notes on the anatomy of *Balaenoptera rostrata*. Proc. Zool. Soc. London, 1870, p. 805–817.

Rabot, Charles.

1914. The whale fisheries of the world. Smithsonian Report for 1913, p. 481–489, pl. 1–3.

Racovitza, E. G.

1903. Expédition antarctique Belge. Résultats du voyage du S. Y. *Belgica* en 1897–1898–1899, etc. Cétacés. Antwerp: 144 pp., 4 pls.

Rawitz, B.

1900. Ueber *Megaptera boops* Fabr., nebst Bemerkungen zur Biologie der norwegischen Mystacoceten. Arch. f. Naturg., vol. 66, part 1, p. 71–114, pl. 5.

Sars, G. O.

1875. Om "Blaahvalen" (*Balaenoptera sibbaldii*, Gray) med Bemaerkninger om nogle andre ved Finmarkens Kyster forekommende Havdyr. Forhandl. Vid.-Selsk. Christiania, 1874, p. 227–241, 1 pl.

1879. Bidrag til en nøiere Characteristik af vore Bardehvaler. Forhandl. Vid.-Selsk. Christiania, 1878, art. 15, 19 pp., 4 pls.

Schulte, H. von W.

1916. Monographs of the Pacific Cetacea. II. The Sei Whale (*Balaenoptera borealis* Lesson). 2. Anatomy of a foetus of *Balaenoptera borealis*. Mem. Amer. Mus. Nat. Hist., new ser., vol. 1, part 6, p. 389–502, pl. 43–57.

Scoresby, William.

1820. An account of the Arctic Regions, with a history and description of the northern whale-fishery. Edinburgh: 2 vols., illus.

Starbuck, Alexander.

1878. History of the American whale fishery from its earliest inception to the year 1876. Rept. U. S. Commr. Fish and Fisheries for 1875–6, p. 1–768, pl. 1–6.

Stevenson, C. H.

1907. Whalebone: its production and utilization. U. S. Bureau Fisheries, doc. no. 626, 12 pp., 3 pls.

Struthers, John.

1871. On some points in the anatomy of a Great Fin-Whale (*Balaenoptera musculus*). Journ. Anat. and Phys., ser. 2, vol. 5, p. 107–125, pls. 6, 7.

1872. On the cervical vertebrae and their articulations in Fin-Whales. Journ. Anat. and Phys., ser. 2, vol. 6, p. 1–55, pls. 1, 2.

1889. Memoir on the anatomy of the Humpback Whale, *Megaptera longimana*. Reprint of the following:

1887–9. On some points in the anatomy of a *Megaptera longimana*. Journ. Anat. and Phys., 1887, vol. 22, p. 109–125, pls. 5, 6; 1888, vol. 22, p. 240–282, pl. 10–12; p. 441–460, 629–654; vol. 23, p. 124–163, pl. 6; 1889, vol. 23, p. 308–335, 358–373.

1893. On the rudimentary hind-limb of a Great Fin-Whale (*Balaenoptera musculus*) in comparison with those of the Humpback Whale and the Greenland Right-Whale. Journ. Anat. and Phys., vol. 27, p. 291–335, pl. 17–20.

True, F. W.

1898. On the nomenclature of the whalebone whales of the tenth edition of Linnaeus's Systema Naturae. Proc. U. S. Nat. Mus., vol. 21, p. 617–635.

1903. On some photographs of living Finback Whales from Newfoundland. Smithsonian Misc. Coll., vol. 45, p. 91–94, pl. 24–26.

1903a. First record of the Pollack Whale (*Balaenoptera borealis*) in the western North Atlantic. Science, new ser., vol. 17, p. 150.

1904. The whalebone whales of the western North Atlantic compared with those occurring in European waters, with some observations on the species of the North Pacific. Smithsonian Contrib. to Knowl., vol. 33, p. 1–332, pl. 1–50, text-fig. 1–97.

1912. The genera of fossil whalebone whales allied to Balaenoptera. Smithsonian Misc. Coll., vol. 59, no. 6, p. 1–8.

Turner, William.

1870. An account of the Great Finner Whale (*Balaenoptera sibbaldii*) stranded at Longniddry. Part 1. The soft parts. Trans. Roy. Soc. Edinburgh, vol. 26, p. 197–251, pl. 5–8.

Turner, William (*continued*).

1871. On the so-called two-headed ribs in whales and in man. Journ. Anat. and Phys., vol. 5 (or ser. 2, vol. 4), p. 348–361.

1871a. On the transverse processes of the seventh cervical vertebra in *Balaenoptera sibbaldii*. Journ. Anat. and Phys., vol. 5, p. 361–362. (Lower transverse process developed in a foetus.)

1882. A specimen of Rudolphi's Whale (*Balaenoptera borealis* or *laticeps*) captured in the Firth of Forth. Journ. Anat. and Phys., vol. 16, p. 471–484.

1892. The Lesser Rorqual (*Balaenoptera rostrata*) in the Scottish seas, with observations on its anatomy. Proc. Roy. Soc. Edinburgh, vol. 19, p. 36–75, text-fig. 1–4.

1905. On *Penella balaenopterae:* a crustacean, parasitic on a Finner Whale, *Balaenoptera musculus*. Trans. Roy. Soc. Edinburgh, vol. 41, p. 409–434, pl. 1–4.

1913. The Right Whale of the North Atlantic, *Balaena biscayensis:* its skeleton described and compared with that of the Greenland Right Whale, *Balaena mysticetus*. Trans. Roy. Soc. Edinburgh, vol. 48, p. 889–922, pl. 1–3, text-fig. 16–25.

1914. The baleen whales of the South Atlantic. Proc. Roy. Soc. Edinburgh, vol. 35, p. 11–21, text-fig. 1–4.

Verrill, A. E.

1902. The Bermuda Islands. An account of their scenery, climate, productions, physiography, natural history and geology, with sketches of their discovery and early history, and the changes in their flora and fauna due to man. New Haven: 8vo, x + 548 pp., illus. (Whales, p. 270–278.)

14 DAY USE
RETURN TO DESK FROM WHICH BORROWED

EARTH SCIENCES LIBRARY

This book is due on the last date stamped below, or on the date to which renewed.
Renewed books are subject to immediate recall.

SENT ON ILL	
NOV 0 3 1994	
U. C. BERKELEY	

LD 21–50*m*-6,'60
(B1321s10)476

General Library
University of California
Berkeley

597